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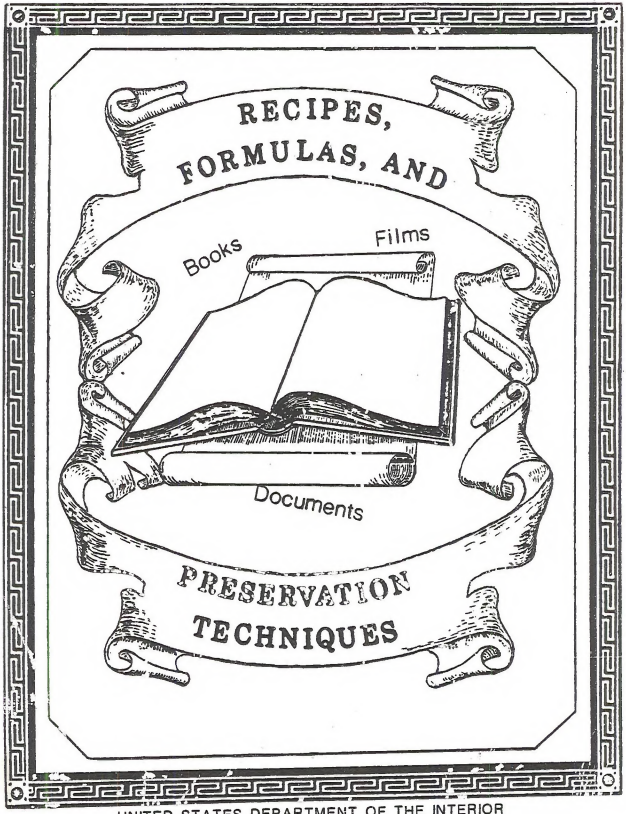

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Bureau Of Land Management

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RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES

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The preservation of books and documents requires the use of chemical substances. These products can be so common that they are found in the home; however, they can also be uncommon and hazardous to the user, work area, or environment if used improperly. Therefore, persons trained in curatorial work must be able to read and understand Material Safety Data Sheets (MSDSs) and must follow MSDS guidelines for the proper use of any chemical.

Other than spot repairs to extend the life of the present book cover, the curator should consider rebinding if the book is of permanent interest or of value. Cadastral survey field note books are an example of the type of book that falls into this permanent value category.

Unless otherwise specified, chemical amounts used in formulation will be designated as ounces. Liquids are measured in fluid ounces, while solids and semisolids are measured as ounces by weight.

LEATHERS AND SKINS

Animal skins were first used as writing materials and later, because of their durability, as book coverings. Animal skin is a continuous membrane of fibrous tissue (Illustration No. 1). Because of its organic nature, it rapidly putrefies unless steps are taken to preserve it. Skins can be cured by tanning, where an acid or acid salt is used to precipitate the protein in the hide, which produces leather. Treatment with lime (calcium oxide) produces parchment and vellum. Treatment with alum (potassium aluminum sulfate) produces tawed skins.

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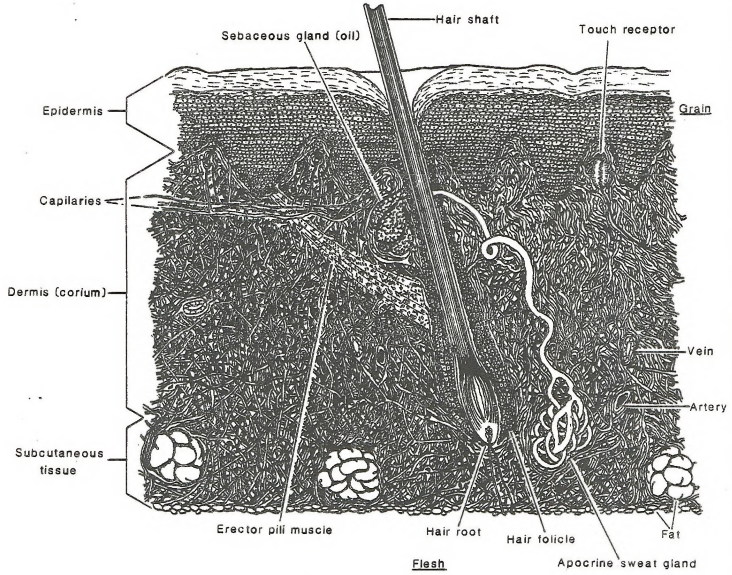
Illustration 1

GENERAL STRUCTURE OF SKINS



- Because of the organic nature of animal skins, some form of treatment is required to prevent putrification. These chemical treatments are known as curing and tanning.
- Animal skin is a continuous membrane of fibrous tissue considered to be the first and only natural fabric.
- The dermis or corium layer is the strongest portion of the skin.
- The subcutaneous tissue layer contains excessive fat and oil which is split or shaved off before the skin can be properly treated.

The curator must become familiar with skins, leathers, and their imitations, since leather dressings are not to be used on artificial leather book bindings, patent leathers, suede leathers, parchments, vellums, or tawed skins. These require a different treatment method.

Leathers are made from the hides of various animals at different stages of growth to obtain desirable characteristics for the application that the leather is to be used for. The more durable and expensive portion of the animal hide comes from the back and sides, while the less durable, softer leather comes from the belly. Belly leather is easily recognized by the grainy appearance of the large pores in the skin where the hair was removed and is seen usually in a swirl pattern. Belly leather has a soft feel to it.

The curator must also recognize leathers that have been stamped with a pattern to make it look like another, more expensive leather. Belly leather is sometimes stamped in this fashion and sold as a more expensive product.

Deciding whether or not to treat the Bureau's large holding of leather-bound (chrome tanned) books involves choosing between saving (1) examples of the book binders' art or (2) the information contained therein. In the event of a water-related disaster, the additional protection afforded the body of the book by the treated book cover outweighs any artistic value that the cover may have. The conservator must keep in mind that leather bindings on most books held by the Bureau are there to serve the primary function of a hard binding, which is to protect the body of the book.

True Leathers

In general, true leather is formed when a skin is impregnated with an acid that is strong enough to cause the protein of the hide to precipitate into an insoluble material. Vegetable tanning using mostly organic acids from the leaves, sap galls, bark (tan bark), and smoke from plants is the earliest known method of leather tanning. Tanning with vegetable matter is a long, slow, and sometimes uncertain method for producing leather with desired or consistent properties. Vegetable tanning was replaced after the discovery in 1858 of the superior tanning properties of chromium sulfate. It was found that the pH of the tanning bath could be controlled to remain between 3.2 to 3.5, giving a consistently high grade of leather in a short time. (See Illustration No. 2.)

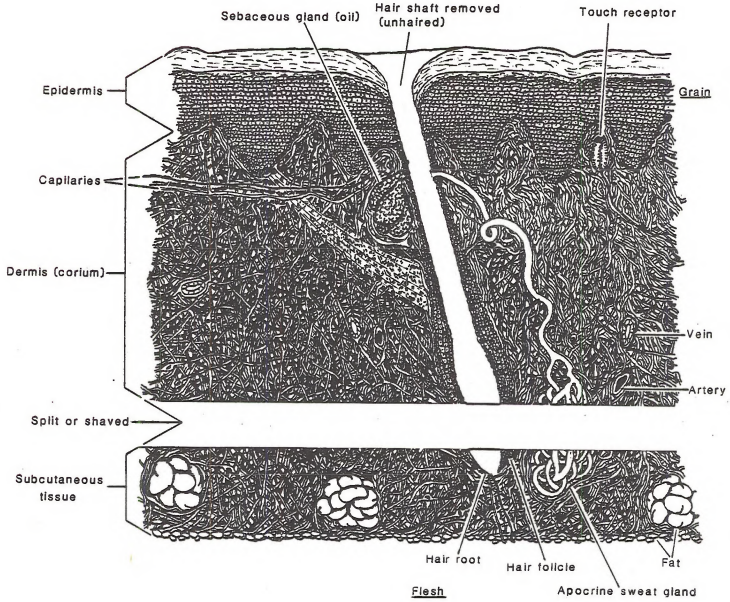
Suede and Roughout

Suede leather is usually made from calf, kid, or lamb skins. The corium layer is buffed to produce a fine nap, leaving the grain side as the inside surface of the article being made. Suedes do not accept dressing well because the nap becomes matted with the oils and waxes in the dressing, destroying the desired appearance of the suede.

Roughout leathers (mostly cowhide) are made from the skins of adult animals and are intended for field use where a rugged and protective surface finish is needed. Dressings will also matte the roughened nap; however, the intent of the protective cover is the primary consideration, not the aesthetics of the book.

GENERAL STRUCTURE OF LEATHER

FOR BOOKBINDING



- The subcutaneous layer and hair are removed prior to tanning.
- Leather is produced when the skin is treated with an acid or solution of acid salts. This chemical process is called tanning.
- Vegetable tanning (tannic acid) was used up until 1858 when it was replaced by chrome tanning (chromium sulfate).
- Leather remains stable in wet conditions.
- Alum (potassium aluminum sulfate) tawed skins are not stable in wet conditions and consequently are not considered to be true leathers.

Tawed Skins

Tawed skins are not truly leathers, even though they have been cured in acid salts such as potassium aluminum sulfate (potash or alum). The skins are also treated with salt (sodium chloride), egg yolk, and flour, and are treated by staking to make them soft. (Staking is the process where an unfinished leather is thrown over a wooden stake and pulled off of it until the leather becomes pliable.) Tawed skins are durable when used in book bindings, but they become unstable in wet conditions.

Vellum

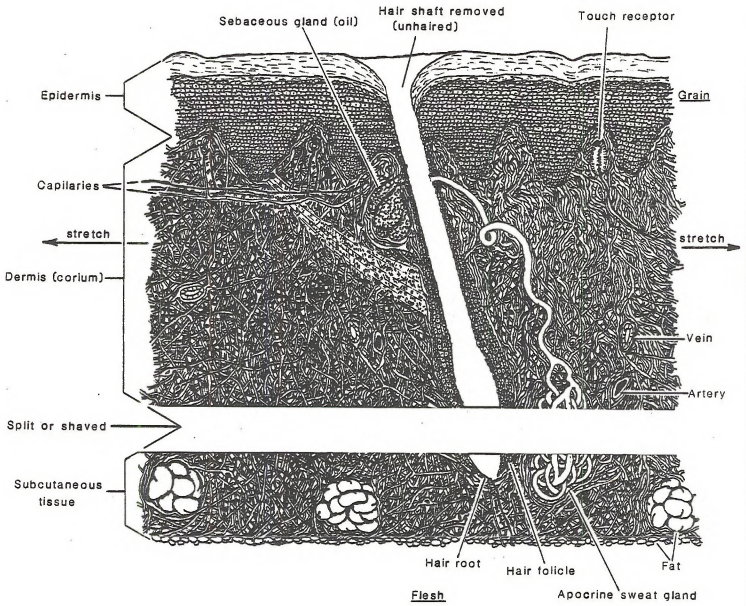
Originally, calf skin was used to produce vellum. It was soaked, limed, unhaired, and stretched on a wooden frame, and was then left to dry at normal temperatures. The stretching made the skin thinner when dry. If water reaches this material, it will revert to its original form. Many vellum book coverings have a whitish translucent appearance, while others are dyed and opaque. Today, vellum is made from many different animal skins. (See Illustration No. 3.)

Parchment

Parchment, like vellum, is soaked, limed, unhaired, and stretched to produce a thin flexible end-product that could be written on or used to cover a hard-board book covering. Some authorities today do not distinguish vellum and parchment as separate materials. Originally, parchment was made from the skins of sheep or goats. The main difference

GENERAL STRUCTURE OF VELLUM

FOR BOOK BINDING



- The subcutaneous layer and hair are removed prior to curing. Gelatin is then extracted from this fatty tissue.
- Vellum is produced using slaked lime (calcium hydroxide) as the curing agent.
- Similar to leather making, the epidermis or grain layer is left on the skin.
- Vellum is stretched into a thin sheet during the drying process.
- Vellum is unstable in damp and wet conditions.

between parchment and vellum is that not only is the subcutaneous layer split from the skin, but the epidermis layer is also removed, leaving only the dermis or corium layer that does not have the distinctive grain of the skin. Products containing water (adhesives or dressings) should not be used on parchment, nor should parchments be kept in areas with humidity levels over 65 percent. (See Illustration No. 4.)

Forel

This product is a low-grade parchment. It is distinguished by its tendency to be greasy, making it difficult to obtain good glue joints.

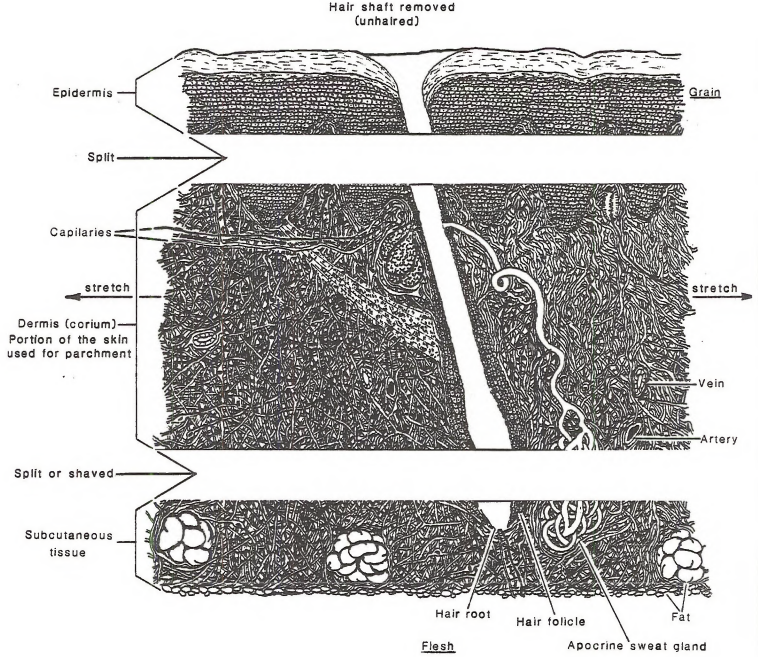
IMITATION LEATHERS

Imitation leathers are sometimes difficult to distinguish from real leathers unless the curator can look at the underside, where there is no evidence of the fleshy or corium layer of the skin. Most common of the imitation leathers is leatherette or pressed paper that has a leather grain (usually morocco) stamped into it. The paper is made resilient by sizing it with flexible pyroxylin, which is also known as collodion or nitrocellulose. Variations of leatherette are sized with gelatin, starch, china clay, or other clays. Fabrics have also been coated with rubber or plastic compositions like polyvinyl chloride to resemble leather. You should consult with the Preservation Officer at the Service Center before attempting any curatorial work on book covers made of imitation products.

GENERAL STRUCTURE OF PARCHMENT

Illustration 4

FOR BOOKBINDING



- The subcutaneous layer and hair are removed prior to curing. The epidermis or grain layer is also split from the skin.
- Parchment is produced using slacked lime (calcium hydroxide) as a curing agent.
- Parchment is stretched into a thin sheet during the drying process.
- Parchment is unstable in damp and wet conditions.

PRESERVATION TECHNIQUES FOR LEATHER BOOK BINDINGS (SMOOTH-FINISH LEATHER ONLY)

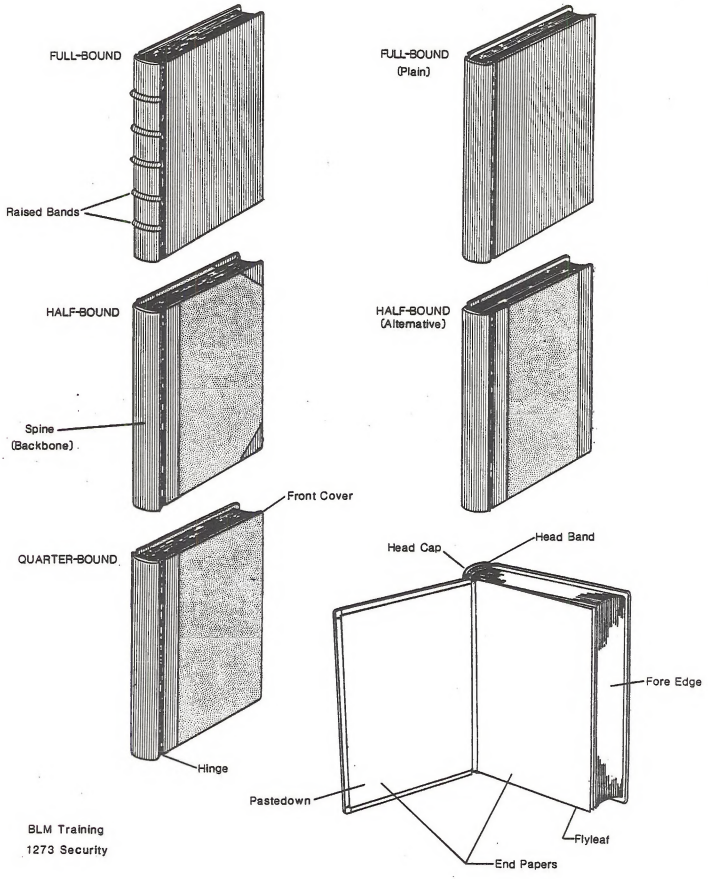
Before applying any dressing to a leather book cover, insert a sheet of waxed paper between the flyleaves and the covers (front and back) so that oils from the dressing will not reach the paper. (See Illustrations No. 5 and No. 6.)

Most dressings must be forced into the grain of the leather. Therefore, you must work the mixture in by using a small circular motion with your fingers to force penetration into the leather. Wear protective gloves that will stand up to this use.

After a very light, even coating of dressing has been applied, let the book stand for at least 2 hours. If the finish appears uneven, apply a second light coat and wait another 2 hours. Before reshelving, use cotton balls to remove any excess dressing from the surface and any that has been forced around the edges of the cover. This treatment will also remove any soil that has been floated up by the dressing. Let the book stand for another 2 hours and then wipe again if necessary before reshelving.

Leather-bound books usually will last longer under regular use if the covers have been properly treated with some type of protective dressing. Treated books will also receive less damage in a water related disaster.

BOOK BINDING



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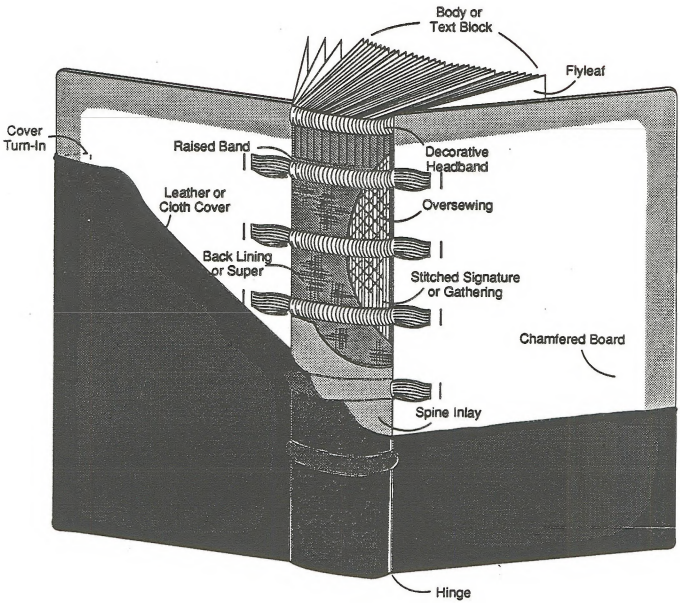
BOOK BINDING
THE ANATOMY OF A BOOK



The curator must carefully inspect and test the title areas on the book cover and spine to be sure that the dressing will not remove the printing. Some leather-bound books have title and author labels printed on paper and glued to the spine. These labels should not be treated with the leather dressing but should receive separate treatment before the dressing is applied.

Avoid mixing large amounts of dressings unless they will be used in a short time. Note: Deteriorated leather cannot be renewed using any dressing. Do not use saddle soap on leather book bindings because of its acid content.

Presently, there is a controversy among conservators regarding whether or not any dressing should be applied to leather book bindings because:

1. Some dressings under high humidity conditions will cause book covers to stick together.

2. Ingredients in some dressings raise the acid levels in leathers.

3. Oils in some dressings penetrate into the book boards and cause them to soften, allowing the adhesive layer to fail.

4. Certain dressings, although they strengthen the structure of the leather, also harden the surface to where the leather will crack.

5. The tendency of the technician in applying dressing is to use too much. The oils from the binding are then carried on the user's fingers to the pages.

6. Some dressings change the esthetic appearance of leather bindings.

7. Only leathers made after 1858 (chrome tanning) are to be treated in the manner described in this section. Vegetable tanned, alum tawed, vellum, and parchment book covers are to be treated using different techniques.

RECIPES FOR LEATHER DRESSING

British Museum Leather Dressing

Anhydrous lanolin	7.0 ounces
Cedarwood oil	1.0 ounces
Refined beeswax	0.5 ounces
Hexane (flammable; see MSDS)	11.0 ounces

In a double boiler, melt the lanolin into the beeswax and then add the cedarwood oil. Remove the mixture from the heat source (eliminate any ignition source) and stir in the hexane. Pour into an appropriate dispensing jar. Let cool before using. Note: Beeswax and carnauba wax have natural acids in them. You may substitute with paraffin wax, which is nonacid. If beeswax is used, the dressing has a tendency to be tacky if too much is applied to the leather. This condition will be most evident where there is high humidity.

Oil-Lanolin Dressing

Neat's-foot oil	10 ounces
Anhydrous lanolin	15 ounces

Melt these ingredients in a double boiler and let cool before using. This mixture can be used as a general leather dressing, particularly when being applied by volunteer or inexperienced help.

Potassium Lactate 7 Percent Dressing

Potassium Lactate 50 percent solution	2.0 ounces
Distilled Water	1 pint
Para-nitro-phenal	0.05 ounces

Do not heat this solution. Read the MSDS for these chemicals and wear hand protection. Do not use this formula for books that have suede finishes or that show red rot. Red rot, or foxing, on leather can be detected simply by rubbing your fingers across the binding and looking to see if there is a powdery reddish dust picked up by your fingers.

Petroleum Jelly

Petroleum jelly can be used as a dressing straight from the jar, or:

Petroleum jelly	7 ounces
Neat's-foot oil	2 ounces
Cedarwood oil	0.5 ounces

In a double boiler, melt the petroleum jelly and then stir in the neat's-foot oil. Remove this mixture from the heat and, while it's still warm, stir in the cedarwood oil. Let cool before using.

CLOTH BOOK BINDINGS

Cloth bindings are used for books because they are less expensive than leather. However, they are also less durable. Generally, there are three forms of surface finish for cloth used as a book covering. Back cloth is a woven fabric (usually, but not always, cotton) that may be bleached, mercerized, dyed, filled with pigment colors, gelatinized, starched, coated or impregnated, calendered, and embossed. Fine linen (flax) and cotton cloth are sometimes sized, glued to the bookboards, and left with a natural finish to show off the fabric.

A second type of finish is attained by coating the cloth and either allowing the weave of the fabric to show or embossing the surface with a desired pattern or grain. This type of cloth is most commonly found on edition binding.

Impregnation is a third type of finish. Impregnating cloth adds to its strength and makes it good for library binding if the impregnating product is pyroxylin or similar material. The surface of coated cloth can be embossed, while impregnated cloth retains the texture of the base material.

Pyroxylin-treated fabrics (buckram) have been in use since about 1910; however, even today the curator will find starch- and clay-filled bindings (cloth bindings or edition bindings) on new editions. Pyroxylin is a good barrier to water; books coated with it receive less damage during the early stages of a water disaster than starch- or clay-filled bindings.

As of May 20, 1986, pyroxylin (cellulose nitrate, a highly flammable compound in its fully nitrated state) has been banned from use by Bureau employees. Although the aesthetic appearance of clothbound books may be lost, other adhesives such as polyvinyl acetate (PVA), methulose, or wheat starch may be used to make spot repairs. Avoiding the use of nitrated pyroxylin helps ensure the protection of the data in books, which is the primary reason for preservation.

There is a low nitrate pyroxylin that is safe to use. Check with the Service Center Preservation Officer for further information on this.

ACID AND ACID-FORMING CHEMICALS

The most insidious threats to any records holding are chemical substances used in the manufacture (acids), processing (mounting, thiosulphate), imaging (inks), and storage (ambient gas) of paper and film documents. These elements contribute to the steady destruction of many valuable records, and their effects are usually unseen by the custodian of the records until it is too late. Overall, these conditions constitute a disaster continuously in progress (creeping disaster), so steps must be taken to preserve each document or book.

DOCUMENT TESTING

Before proceeding with any preservation work, the conservationist must perform the following tests:

1. Soluble Inks

Inks used for writing or printing on the document must be tested with all chemicals (including water) the curator plans to use during the preservation process. It is important to inspect the spot being tested with a magnifying glass or hand-held microscope both before and after each test is performed.

Note: When testing a book, place wax paper, a plastic sheet, or other material between the pages; this will act as a barrier to keep the test chemical from migrating to the adjoining pages. Be sure the test chemical will not melt the barrier material.

Dip a cotton swab into a small container of the chemical to be used during the preservation work. Roll the swab around the lip of the container to remove excess liquid. Carefully place the moist swab onto the surface of the document.

When testing a handwritten document, the swab should be held in place on a word so it touches only the tail stroke of a letter in an unobtrusive place. After about a minute, remove the swab and look at it to see if it lifted any of the ink. Depending on the preservation technique being administered, such as full immersion of the document, a different procedure may have to be chosen if the ink proves soluble in the proposed solvent.

Testing of printed images and letters is somewhat different. An entire letter or colorspot may have to be covered by the swab in order to perform a solubility test.

Before proceeding with the preservation work, allow the tested spots to dry. Inspect them with a magnifying glass and note if any of the solvents tested have removed the sizing from the paper, forcing the ink to lift, or if it was only the ink that was lifted or feathered. If the fibers of the paper have been fluffed by the solvent, it is a clue to guide the curator away from using a chemical that can cause extensive damage to a document by dissolving the ink or sizing.

2. Acidity

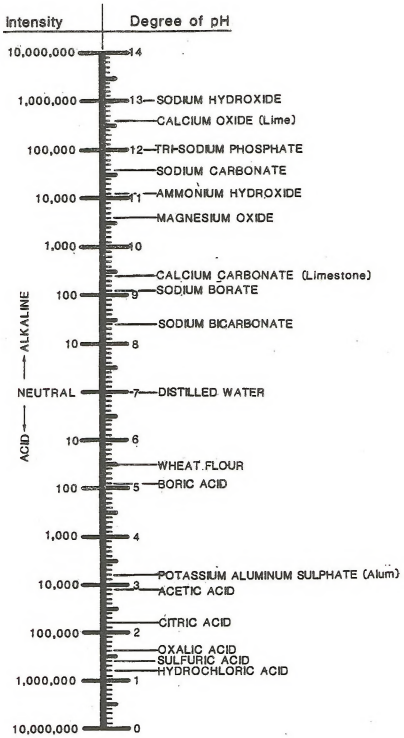
There are several different pH tests that the conservator should be aware of. Again, testing must be done while using a barrier sheet between the pages. See Illustration No. 7.

Illustration 7

POTENTIAL OF HYDROGEN

(pH Scale)

0.1 normal solutions



A. The pH Meter

The pH meter is an expensive piece of apparatus (from about $200 to $2,000) that requires calibration and must compensate for temperature and concentration. Although it is the most accurate test, portions of the paper being tested must be destroyed in order to do the test. Time is another factor, since meter tests are made on measured portions in hot solutions. These electronic meters are best suited to a laboratory environment.

B. The Indicator Stick

The indicator stick is a plastic strip with four colored pads adhered to one end. Each pad is impregnated with a different nonbleeding chemical reagent that will change color when contacted with different degrees of ionization. The color changes (while still wet) are compared to a color chart showing 1-unit pH intervals. Equivalent coloration of the indicator pads is accurate to $\pm$ 0.5. The dry indicator stick reads neutral. By dipping the strip into distilled water and then pressing it to the surface of the paper being tested (in a nonimage area) for about 2 minutes, the water will create a microsolution with enough ionization to cause the indicator pads to react. These indicator strips are an inexpensive, fast, and portable test method that can be used by the curator anywhere, including a disaster site, as long as distilled water is available.

C. The Indicator Pen

The indicator pen, even though it leaves a stain, can be used to advantage by the curator, especially in a mass treatment situation. The pen looks like any other fiber tipped pen, except this pen is filled with an indicator solution (pH neutral) instead of ink. When the tip is touched to paper, it leaves a color stain (a small colored dot) ranging, for example, from yellow through green to dark blue. The instruction sheet accompanying the pen tells which colors indicate acids or alkalies. In printed books, the curator should always test the same place on the same page in every volume (for example, the lower inside corner of page 10). Since this is a quick test, the paste down or board paper (the end paper that is glued to the book board) can easily be tested as well (and should be).

The advantage of this testing procedure is that the color mark tells the curator which volumes have been tested and which have not. It also provides a quick method for rechecking pH. If the book is put through deacidification, a second test should definitely be performed. The presence of two dots of different colors will be a permanent indication that the book has undergone treatment.

Documents such as field note books pose a different problem because they are made up from separate gatherings or signatures of paper from various manufacturers and manufactured batches. As with other books, test the paste down and a chosen page; then test the first page of each succeeding signature.

D. Acid in Early Inks

It is important to note that the old permanent inks like iron gall were made using sulphuric acid as a clearing agent . Sulphuric acid was also used in the formulation of other early inks. These inks contribute to the formation and migration of acid in paper. Refer to the "Ink Testing" portion of this booklet.

E. Tests for Fiber and Fill

You should test for fiber and fill only if there is some question as to the fiber makeup of the paper you are working with. When using the tri-test paper testing kit, follow its instructions as closely as possible. Test spots should be as small as possible and not in an information area. Tables 1 and 2 provide information as to the reagent that is used to identify the paper fiber and also the sizing material that is used in the paper.

3. Document Preparation and Cleaning

Preparation of documents for treatment requires more than merely arranging (when necessary) by date order, file order, case order, etc. Given the requirement for using water-soluble substances, metal objects such as paper clips, staples, and binder clips must be removed to prevent rust stains before any treatment is begun.

TABLE 1
REAGENT TESTS FOR PAPER FIBER IDENTIFICATION

Fibers	Iodine	Zinc-chloro-iodine solution	Phloro-glucinol solution	Herzberg's Stain
Cotton and Linen	Light to dark brown	Strong wine red		Red
Chemical wood	Almost color-less to light brown	Blue		Blue
Mechanical wood	Yellow to brown	Yellow	Dark Red	Yellow
Straw Esparto	Almost color-less to light brown	Blue		

These tests are not infallible and when precise identification is mandatory, the fibers should be identified under a microscope.

The Tri-Test paper testing kit using these chemicals is available from:

University Products, Inc.
P.O. Box 101
517 Main Street
Holyoke, MA 01041

Note: Keep this kit refrigerated.

Call collect for pricing (413) 532-9431
Cat. No. 455-0001 Ask for Material Safety Data Sheets when ordering

TABLE 2
Sizing

Reagent	Alum/Rosin Sizing	Gelatin	Clay	Starch	Collodion
Aluminion	Lt. Pink (When dry)				
Potassium Iodide				Iodine Stain	
Hot Water		*Swelling	*Swelling		
Ethyl Alcohol					Dissolves

*Both gelatin and clays swell when contacted with water. To differentiate, apply a small drop of water and allow it to sit for one minute and blot (do not rub). Observe under a microscope. Some of the clay will be lifted and you may see some separation of the paper fibers. The gelatin will remain intact.

The removal of certain adhesive products, such as adhesive mending tapes, should then be considered. Because of the extensive variety of adhesive products, refer to the training booklet, "ADHESIVES," which contains detailed descriptions of adhesive products, their properties, their use, and techniques for their removal.

Once the above preparation steps have been completed, the document is dry cleaned. To clean a paper document, use the following procedures:

Step 1. Remove surface soil using K & E Draft-Clean, Opalene, or ABC Dry Clean Pad..

A. Knead powder from pad or bag onto document. Rub with the fingers using a circular motion over the entire surface. Remove powder with brush.

B. If this does not effectively remove soil, knead powder onto the document and rub with the pad or bag itself.

Step 2. When cleaning powders are not effective, use an art gum eraser.

Step 3. Dirty spots may be removed with a "Pink Pearl" eraser.

Step 4. Chemically treated rubber dry cleaning sponges are most effective for removing soot and smoke odor from books, paper, walls, and office fixtures. Care must be exercised when using these sponges on the face of documents as they have an abrasive equivalent of the pink pearl eraser.

Step 5. As a last resort, a putty type of wall paper cleaner may be used. Do not use any liquid cleaners.

Note: Care should always be taken to remove all eraser residue from the surface of paper and the spines of books before they are placed back in storage.

For a listing of solvents that can be used to remove stains, refer to Table 3.

4. Deacidification

Before any preservation work is begun, such as mending or paper replacement, the preservationist, if necessary, must deacidify the document . Single sheet techniques are different than those used on books; however, some book techniques can be used on single- sheet configurations. Various techniques include total immersion, vapor, sprays, gasification, and vacuum/pressure gasification. The chemistry can be either inorganic or organic, and the solutions can be either aqueous or nonaqueous.

Because acid materials are used in the manufacture of paper, they cannot be totally removed. They must therefore be neutralized, preferably into an insoluble salt, or at least into a salt that has a low solubility rate. Deacidification cannot bring old paper back to a new condition, nor can it by itself replace the sizing that has been lost during the aging process. (However, resizing can done along with the deacidification operation whenever necessary.)

TABLE 3
STAIN REMOVAL

The following solvents have all been reported to have been successful in removing the stains listed opposite them. Because of the technique involved, only a trained preservation officer should attempt to do this type of stain removal. Check the latest Materials Safety Data Sheet (MSDS) before using any of these chemicals.

Stain	Solvent
Adhesive tape	VM & P Naptha
Ball point ink (some)	Dimethyl formamide
Duco cement	Acetone
Fly specks	Hydrogen peroxide
Glue	Warm water
Grease, fat, oil	Hexane, toluene, white gasoline, pyridine, dimethyl formamide, 1,1,1-Trichloroethane, inhibited, and xylene mixed
Iodine	Ethyl alcohol
Lacquer	Acetone
Lipstick	3% tartaric acid followed by water
Mildew	Ethyl alcohol
Mud	Water, ammonia
Natural resins	Ethyl alcohol, methyl alcohol, morpholine
Paint	Turpentine, pyridine, alcohol
Paste	Water
Pressure sensitive tape	Hexane and toluene mixed, VM & P Naptha
Rubber cement	Carbon disulfide, toluene (USE EXTREME CAUTION)
Rust	3% oxalic acid
Shellac	Ethyl alcohol, methyl alcohol
Tar	White Gasoline, 1,1,1-Trichloroethane, inhibited, pyridine
Tea and coffee	Potassium perborate
Varnish	Ethyl alcohol, methyl alcohol, pyridine
Wax	Hexane, toluene, chloroform, carbon disulfide, white gasoline

Deacidification, to be effective, should leave buffers in the paper. These buffers can activate when there is any movement of acid into the paper and can energize when lignin, if present in the paper, becomes recharged.

Serious consideration should also be given to deacidification of newer documents as time allows. Deacidification at an early stage can stop the deterioration that has damaged many older documents. Newer documents then require less preservation work later on because acid damage will not have taken place.

A. The Cunha Cocktail (Aqueous Solution)

The Cunha Cocktail is the least expensive, and one of the simplest, deacidification processes available. Its most common use is the deacidification of newspaper clippings and single documents in the home because it is nonhazardous to use. Assuming a document has tested acidic and does not have soluble inks, you will need:

1. Photographic glass tray approximately 27" x 22" x 4" or plastic kitty litter pan (1)
2. Window screen - fiberglass (1 roll)
3. Bottle of Club Soda - 1 qt. or 1 liter (refrigerated)
4. Nonflavored (preferred) Milk-of-Magnesia tablets (2)
5. Formaldehyde
6. Blotters or white, unembossed paper towels
7. Waxed paper
8. Cloth or plastic clothes line with spring-type clothes pins
9. Rubber gloves
10. Apron
11. 2" paint brush
12. 3/4" plywood
13. "C" clamps (4)
14. Eye protection (do not wear contact lenses when using any chemicals).

Cut a piece of the window screen at least 2 inches longer in each direction than the documents you are treating. For example, an 8 1/2" x 11" document would require a support screen 10 1/2" x 13". Economically, this should be the smallest screen you should cut. If you try to handle wet paper, it can fall apart. The screen is used to support the document while it is wet.

After testing for solubility of inks and potential paper damage, and only if the tests are negative, proceed as follows:

Protect your eyes, hands, and body with appropriate attire.

Crush the milk of magnesia tablets in a small, nonmetallic container and add enough water to make a thin solution.

Pour the entire contents of the club soda bottle into the tray, then add the milk of magnesia solution in a back-and-forth motion over the tray. If environmental conditions exist that favor mildew growth, add a teaspoon of formaldehyde into the mixture. Slowly mix the solution, stroking back and forth with the paint brush.

Lay the document on the support screen and immerse it in the solution. The document will tend to float, while the screen will sink. Gently push the document to the bottom of the tray with the tip of the bristles. Do not use a brushing motion. Wait at least 2 minutes, and then position the document in the center of the screen and lift it from the solution. While holding only the screen, allow any excess

solution to drip into the pan. Using the spring-type clothes pins, fold a small portion of the screen (do not include any of the document) over the clothesline and clip in place. (See Illustration No. 8.)

As the document air dries, it will begin to peel away from the screen. Carefully remove the document from the screen and lay it on a sheet of waxed paper to further air dry.

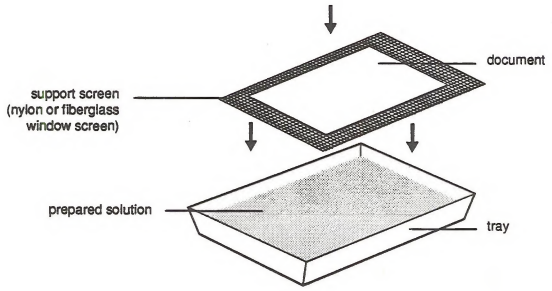
At this time, treatment of the next document can be started. The solution is considered active until gas bubbles are no longer formed in the mixture as it contacts the acid in the paper.

When the moisture content of the first document lowers to a certain level, the stresses within the paper produced during its manufacture will result in puckers known as cockles. Before this distortion progresses beyond the point where it can be reversed, move the document to the document press (see Illustration No. 9).

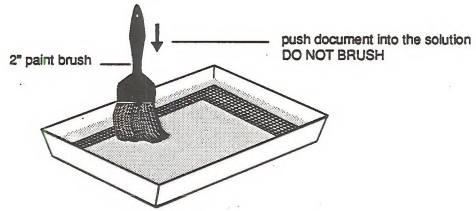
Place a sheet of blotting material on the 3/4-inch piece of plywood. Over this, lay a new sheet of waxed paper upon which the document is positioned. Then add another sheet of waxed paper and blotting material. Temporarily lay the second sheet of plywood on top until the next document is ready. Continue this process until all documents are deacidified or until the accumulated pile (including plywood boards) is about 2 inches thick. Then clamp the pile together as evenly as possible. (See Illustration No. 9.)

TREATING SINGLE PAPER DOCUMENTS IN AQUEOUS SOLUTIONS

1.



2.



3.

- lift the wet document using the screen as a support
- air dry the document to the point that it can be handled and proceed to finish drying

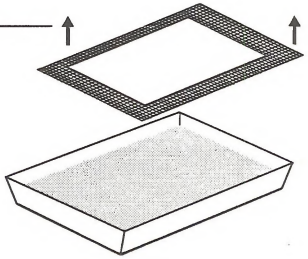
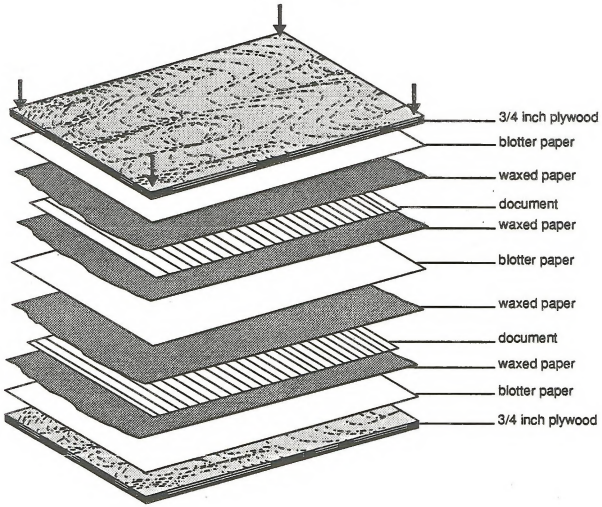


Illustration 9

THE CONSERVATOR'S GENERIC DOCUMENT PRESS

TRAINING

- Cut plywood about 2 inches larger (length and width) than the documents being treated.
- Use 4 C-clamps (6 inch) to apply pressure. Adjust clamps so pressure exerted is approximately the same on all 4 corners.
- Treat "same-size" documents in groups whenever possible.
- All documents being dried should be sandwiched between 2 sheets of waxed paper. Never dry documents against bare wood.
- Unembossed, white paper towels can be used in place of blotting paper.



- Do not load more than 2 inches of material into the press at one time.
- Do not confuse this configuration with the packaging method prescribed for disaster packout. In a disaster situation, substitute bricks wrapped in freezer paper for C-clamps until the press is loaded to approximately two inches. Remove the bricks and bind the bundle with stripping tape.

Depending upon ambient relative humidity, the waxed paper and blotters may have to be changed within 4 to 8 hours. Another 24 to 48 hours will be necessary to allow the documents to properly dry. Occasionally check each bundle of documents to determine if mildew is forming. If this problem arises, lightly spray the infected area with a 3 percent water solution of formaldehyde or a saturated solution of thymol in ethyl alcohol. (Check the Materials Safety Data Sheets.) Waxed paper will show the effects of being in contact with water from the deacidification solution; however, when both the waxed paper and the blotting material are properly air dried, they can be reused three or four times.

In all probability, a nipping press will never be made available to you. However, its use in book binding and preservation should at least be mentioned. The nipping press is sometimes mistakenly called a book press. It provides a quick and even pressure on book covers that are being hot glued to book boards, and eliminates wrinkles and puckers on the finished book's hard cover. The pressing surface of nipping presses comes in two sizes: 12 inches by 10 inches and 18 inches by 12 inches. The larger size can be used on legal-size documents. The benefit of using the nipping press as a single document press is that the two pressure plates are smoothly finished and thus produce an even, parallel pressure when closed. This ensures that the repaired surface being pressed is brought into flat contact over its entire area and is thus made to adhere evenly without cockling. This is desirable both for single documents and for

books. When using this press, you must position the documents or books squarely in the center of the press plates, so that the pressure being applied is even. See Illustration No. 10.

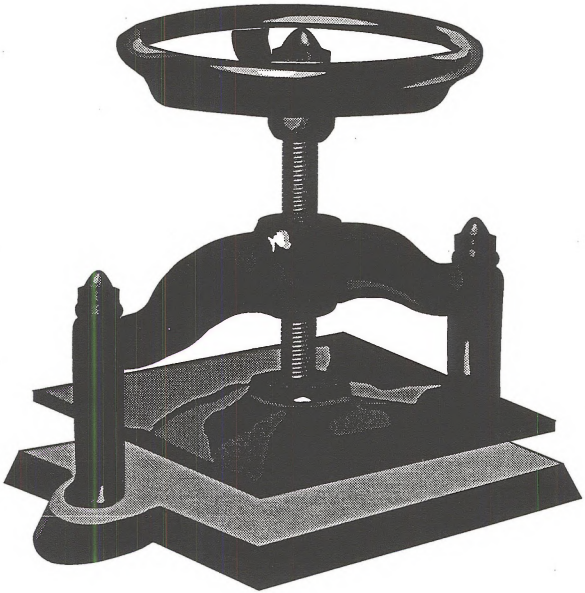
B. Water

Distilled water is not commonly thought of as a deacidification agent. However, acids that have formed in paper can either be diluted or almost entirely soaked out of the paper fibers by using simply water. However, there is no guarantee that new acids will not form later, since there is no buffering agent left behind in the paper.

Tap water usually contains dissolved salts of calcium, aluminum, magnesium, and manganese that can combine with some of the acid in paper to form insoluble salts. Unfortunately, some forms of iron and copper may also be present, which can cause stains in the paper.

In addition, when paper is treated with softened water, traces of sodium salts are left after final washing and drying. Paper is hydrophilic -- it has an affinity for water and must have a minimum of at least 5 percent moisture to remain pliable. When sufficient humidity is present in the air, paper will absorb enough additional water to ionize the sodium salts into sodium hydroxide and other ions. The sodium hydroxide will attack the cellulose fibers of the paper which, in turn, will cause the

NIPPING PRESS



paper to disintegrate. Sodium hydroxide, with controlled chemical processing and removal, is used in the papermaking industry to digest wood pulp.

Deacidification using aqueous solutions (water) is not practical for books or mass quantities of single sheet documents. And water is definitely not suitable when the documents to be deacidified are imaged with water-soluble inks.

The estimated cost of $1.10 per single 8 1/2" x 11" sheet (labor, materials, drying time, etc.) for the water deacidification process may be considered expensive until it is weighed against the value of the document and against some of the nonaqueous deacidification processes, where the reaction chemicals used are not only toxic but present explosive hazards to the user. In order to obtain the proper conditions for handling these nonaqueous chemicals in an environment where they are safe to use, and to attain the desired results, safe chemical hoods, vacuum and/or pressure chambers, chemical handling and storage equipment, refrigeration units, chemicals, and protective equipment for the workforce all must be purchased. These high initial costs must be taken into account.

In many instances, aqueous methods are safer, easier, and far less expensive. The final choice of technique depends on the volume of documents to be deacidified, their value, the presence or absence of water-soluble inks, and whether books or single documents are involved.

C. Wei T'o Solutions

Wei T'o solutions are available commercially in liquid form for dip tank use, in pressure spray cans, and in large-volume cylinders, the cylinders being the most economical for extensive deacidification projects. These halogenated hydrocarbons (see Chemical Reference Chart) are relatively safe to use if the precautions as stated in the Material Safety Data Sheets are followed. Both single documents and books can be deacidified successfully, as these products are nonaqueous and do not present the drying difficulties of the water-based deacidifiers. The propellent, trichlorotrifloroethane (freon), serves as a solvent to inhibit the formation of a gel (magnesium hydroxide) in the paper that acts as a barrier to the deep penetration of the methoxy magnesium carbonate or ethoxy magnesium carbonate deacidification agent (depending upon which spray is used).

CHEMICAL REFERENCE CHART

Chemical Name	Used for: Document Preservation	Containers	Flammable/ Nonflammable
(Wei T'o Solution No. 2) Trichlorotrifluoroethane & methyl alcohol	Deacidification	Bottle	Addition of excess water will extract methyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o Solution No. 3) Trichlorotrifluoroethane & ethyl alcohol	Deacidification	Bottle	Addition of excess water will extract ethyl alcohol and may form a flammable supernatant liquid layer.

CHEMICAL REFERENCE CHART (Continued)

Chemical Name	Used for: Document Preservation	Containers	Flammable/ Nonflammable
(Wei T'o Solution No. 4) Trichlorotrifluoroethane & ethyl alcohol	Deacidification	Bottle	Addition of excess water will extract ethyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o Spray No. 10) Trichlorotrifluoroethane & methyl alcohol	Deacidification	Spray can	Addition of excess water will extract methyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o Spray No. 11) Trichlorotrifluoroethane & ethyl alcohol	Deacidification	Spray can	Addition of excess water will extract ethyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o Spray No. 12) Trichlorotrifluoroethane & ethyl alcohol	Deacidification	Spray can	Addition of excess water will extract ethyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o "Soft Spray") Chlorodifluoromethane, Trichlorotrifluoroethane & methyl alcohol	Deacidification	Spray can	Addition of excess water will extract methyl alcohol and may form a flammable supernatant liquid layer.
(Wei T'o Cleaning Solution) Chlorodifluoromethane, Trichlorotrifluoroethane & methyl alcohol	Document Cleaning	Bottle	Addition of excess water will extract methyl alcohol and may form a flammable supernatant liquid layer.

The magnesium carbonate reacts with any ionized acid compounds in the paper and neutralizes them. Any excess water in the paper is changed into magnesium hydroxide after the volatile solvents have evaporated. The hydroxide thus formed acts as a benign alkaline buffering agent in the paper to prevent any future recontamination. During the chemical reaction, alcohol is formed. Therefore, care should be exercised to prevent excessive breathing of fumes or bodily contact with the solution by workers. Also keep in mind the possibility of fire; alcohol is highly flammable.

Some inks may be affected by the solvents in these solutions, especially those with a heavy oil base. Electrostatic toners (such as Xerox) can also be affected. Inks should therefore be tested for solubility before treatment.

The dip tank treatment technique is used for single documents only, since single documents can be totally immersed in the solution. If the spraying technique is used, spraying must be done evenly. The paper must be saturated to the point that it becomes translucent. In the case of the bristol papers used for cadastral plats, both sides of the plats must be treated or the translucency will not appear, nor will the solution penetrate through from one-side spraying. Books are treated by spraying every other page opening.

D. Diethyl Zinc (DEZ)

National Archives has developed a method for the mass deacidification of documents and books. This new technique requires a specially constructed facility with sophisticated controls and equipment, given the explosive nature of the deacidification chemical. Basically, the facility consists of a large vacuum/pressure chamber into which documents are loaded. The air and water vapor are pumped from the chamber. The chamber is then flooded with DEZ under pressure so it remains in a liquid state. The documents must be submerged in this liquid until they become totally saturated in order to attain total deacidification of books and piles of single documents. A vacuum is again pumped in the chamber, which removes the DEZ and any alcohol formed during the deacidification reaction as gasses. The DEZ must be totally removed; otherwise, it will explode with great violence upon contact with air and moisture. The buffering agent left in the paper is a zinc-based compound.

It is estimated it will take as long as 20 years for the National Archives to deacidify their information holdings. The DEZ process may be unavailable to the Bureau during this time.

DOCUMENT REPAIR

To properly repair paper documents, one must understand how paper is made. Paper is a macerated conglomerate of fine, cellulose fibers that is treated in different baths during manufacture so that it will mat or felt

together in its finished form. The last steps of manufacture include pulling a continuous sheet of paper from a fourdriner (felting machine) into a calender. A calender is a machine with rollers heated by steam. The setting of the machine can determine the weight and the strength of the paper. By inserting different rollers, the surface finish of the paper can be made glossy, smooth, or rough.

Paper, as it comes out of the fourdriner, is being pulled; this forms a grain. Usually this grain is vertical in the finished paper because of the way it is cut from the bulk roll. When making repairs on documents, one must take into account the grain of the paper; the surface finish of, and the sizing in, the paper; the thickness of the paper; and the color of the original document in choosing which repair paper should be used.

The papers most used in preservation work will either be the Sekishu, which is a thicker, heavier paper, or silk tissue paper. The silk paper is made with very finely divided, long fibers and makes a translucent patch. Although these are the most popular papers for document repair, one should consider other types of archival paper to match the finish of any document repair being done.

Before any document repair can take place, the trained preservationist must first test for soluble inks and then deacidify the document. If possible, stains, such as those caused by scotch tape, should also be removed. This is not work for the novice.

Scotch tape or the equivalent can be lifted by using a pair of tweezers, a cotton swab, and a solvent. By lifting the edge of the Scotch tape with

tweezers and touching the document with the swab soaked in the solvent, the tape can be lifted, but the stains left by the adhesive may not always come off with this treatment. Be sure that all of the adhesive substances are removed during this operation. This is done by allowing the document to dry and then touching it to see if the surface that was taped is still sticky. This treatment should be done without abrasively rubbing the surface of the paper where any of the textual information is present.

Once the document is cleaned by using the methods described elsewhere in this document, the preservationist should first begin with a microspatula and methyl cellulose adhesives and repair the feathered edges along any rips in the paper while working under a magnifying glass. The preservationist will note that many of the rips and tears in a document have a feathered edge. This feathered edge can occur on either side, or on both sides, of the paper, even with a single tear; check each tear carefully before beginning any repair work to ensure that the feathered edge is properly mated with the damaged side of the paper. A small amount of adhesive such as methyl cellulose is applied to these feathered edges using a microspatula; this will hold the paper in place until the patch can be applied. This is probably the most tedious part of the preservation work. After the rip has been seamed up using the preceeding technique, allow it to dry, preferably under pressure.

The next step in the process is to form the patch. A patch is always torn rather than cut to give the paper patch a deckled, or feathered, fibrous edge. The repair paper can be ripped along a straightedge if, for instance, you are forming a spine repair on a book. Another method is to rip the patch you need from the repair paper so that it is large enough to

fit over the damaged portion. In a third technique, the preservationist uses water and, with a fine paint brush, paints around the size of patch that is needed to make the repair. The patch is then pulled from the repair paper by tearing it along the water line.

Place the repair patch onto the document after the adhesive has been applied to the general area of the repair to be made. Let the patch overlap the edge of the paper by at least one-half of an inch. Later, this flap can be neatly trimmed off with an xacto knife or scalpel to match the edge of the document. Once the patch is in place, the repair paper should then be burnished in directions away from the damaged area. This removes excess adhesive and works the deckled edges of the patch into the fiber of the document paper, resulting in a patch that is very strong and flexible and that does not present a straightedge that can be lifted when the edge of another paper is slid against it.

The type of document will determine where and how the patch is made. On a single-sided document, the repair should always be on the unprinted side of the paper. Paper printed on both sides can generally be patched on either side. For handwritten, two-sided single documents or book pages, the repair should be made on the side that has the least valuable information.

Cloth-backed documents, such as the cadastral plats, are probably the easiest to make the repairs on. If the document face has cracks or loose flaps and the backing fabric is not torn, repair is simply a matter of resizing by gluing the cracks down in place, using a wheat starch type of adhesive. The adhesive fills the cracks in the paper and also adheres to

the fabric backing. If the cloth on the fabric-backed document is torn, it is a simple matter to patch over the torn area, using about the same grade of muslin. Illustration No. 11 shows how this process works.

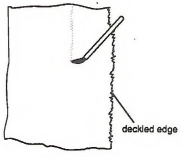
When using any of these techniques, cockling will take place in the paper because of the use of a water-based reversible adhesive. Consequently, as each repair is made, the document should be allowed to dry using the generic document press (see Illustration No. 9). Also, when working on a single-page document, the document should be laid onto a sheet of waxed paper or silicon release paper. In the case of a book, you must interleave the side away from the repair with wax or silicon release paper and a blotter, repeating the interleaving over the patch before the book is closed for pressing and drying.

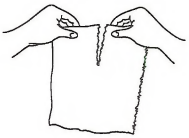
On the side that the patch is made, the appearance of the document can be matched by using wax paper and a blotter to form a glossy finish or an uncoated matte surface polyester (mylar) film to form a matte finish. A blotter is not necessary with film because the water cannot penetrate the mylar material. When the mylar films are used, the drying time is longer, possibly requiring a combination of both air drying and drying in the press. When the patches are thoroughly dry, inspect each one to be sure that there is good adhesion between the patch and the original paper.

Illustration II

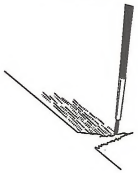
HOW
TO MAKE A PATCH

1. Either tear the patch from the repair paper or outline an area with a fine brush and water, then tear the patch from the repair paper, which leaves a feathered edge (deckled edge) around the patch. The size of the patch should cover an area at least one half inch around the repair.

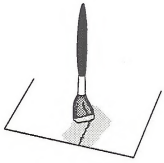




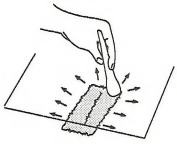
2. Apply adhesives along the edges of the tear with a fine brush. Press in place and allow to dry.



3. Apply adhesive to the area that will receive the repair paper.



4. Position the patch over the area to be repaired, leaving about one-half inch overlap. Burnish the fiber of the patch into the surface of the paper being repaired and then place the document into a press to dry. Trim the excess patch off.



CONSERVATION PAPERS USED FOR DOCUMENT REPAIR

Recovery from any of the three types of disasters (Acts of God, Acts of Man, or Creeping Disaster) requires that sound repairs be made to documents and books. Never use adhesive tapes or films. Only acid-free mending papers and acid-free, water-reversible adhesives are allowed for conservation work. Muslin cloth may sometimes be used.

Only persons trained in restoration techniques are to attempt repair of vital documents. Each location should plan to train an employee in conservation methods. The curator must become familiar with some of the conservation papers and their applications to document repair. Conservation papers are listed and described below.

Antique Endleaf Paper - Endleaf 80-pound text weight paper with a laid finish for new books or restoration. Finishes include white, unbleached, or colored in a Florentine or Marbled pattern.

Bodleian White Paper - Handmade in England, 100 percent rag (cotton and manila). It is watermarked and has a laid finish. Among the oldest repairing papers for books and documents, it is very strong and soft and is acid-free.

Edinburgh - Handmade by the Barcham Green Mill, this 50 percent cotton, 50 percent flax paper is especially popular with conservators for book repair. This acid-free, deckled sheet has a pleasant toned color which blends in well with 17th and 18th century papers.

Hosokawa Ohban - A handmade sheet of 100% Kozo, this paper is most popular with conservators as a backing or support sheet for maps, documents, etc., especially in larger pieces because of the slightly "heavier-than-usual" weight of most Japanese papers.

Kitakata - Handmade in Japan from mitsumata and sulphite pulp. The buff shade and silky touch of this paper make it a favorite with conservators of old books and documents. Also used for wood cuts, etchings, and Chine Colle applications. This paper is acid-free and deckled on four sides.

Kizukishi - This silky 100 percent Kozo sheet paper is natural in color, even in body, and has a hard surface. Created by master craftsmen of Japan, it is specially made for mending since its fibers are compact and can be torn into a strong web. This paper may be used for bookbinding.

L Tissue - Machine made in England from manila, this acid-free white paper is used for laminating documents and can also be coated into heat-set tissue. It is lightweight, strong, very versatile, and has some wet strength. It may also be used for bookbinding.

Mulberry Paper - This white paper is handmade in Japan from Kozo and sulphite pulp. Its name comes from the mulberry plant from which the Kozo fiber is taken. Lightweight and soft, it is strong, very versatile, and pleasant to use. In addition to its conservation uses, this paper is excellent for printing or printmaking.

Okawara - This fine handmade Japanese paper typifies the best in Oriental papers. Strong, soft, and supple, its laid lines are nearly invisible. It is acid-free and has deckles on four sides.

Rives Lightweight, White - A French, moldmade sheet, acid-free, 100 percent cotton, with a woven formation. It is popular for use as replacement end-sheets or fly-leaves in book repair and is one of the few woven sheets available in this category.

Sekishu - Handmade in Japan from a mixture of kozo and sulfite pulp. This is the largest handmade sheet currently available. For wood engraving and block printing, it is not recommended for offset printed documents. Available in white and natural colors, this paper has deckles on four sides.

Sekishu Kozogami Turu - Handmade in Japan, 100 percent kozo. Practical for all types of repair work, this off-white paper has deckles on four sides.

Sekishu Natural Hinging Paper - Used for making archival print hinges with the proper adhesives; also used by paper conservators to mend damaged or torn documents.

Sekishu Torinoko Gampi - This 100 percent Gampi paper is a rarity among Japanese papers. Created and made by one of the master craftsmen of Japan, it is top grade for the preservation, conservation, and repair of valuable art objects on paper. Soft and silky, this naturally colored paper looks almost as if it were glazed. It is very strong in spite of its light weight.

Silk Tissue - Machinemade in Japan with a large portion of gampi. It is a very silky paper that is also very transparent. It is excellent for interleaving, for overlays on prints, or over illustrations in books. This paper is white and acid-free.

Tosa Tengujo - A handmade, 100 percent kozo paper with especially long, silky fibers that give the paper an almost woven look; lightweight.

Turu Kozogami - This 100 percent Kozo paper is very soft and silky in appearance with chain lines. Its great strength makes it practical for all types of repair work.

Uda, Thin - Made of 100 percent Kozo, Uda, Thin is a very lightweight tissue, natural in color with laid information and exceptionally soft touch. Its antique look lends itself extremely well to the repair and conservation of very old books and documents. This acid-free paper has opacity without bulk.

Udagami - Made of 100 percent Kozo, this exceptionally lightweight paper has very narrow laid lines and chain lines 1 inch apart. Although this paper looks very delicate and fragile, it is strong and opaque. It works best in the repair of valuable art objects on paper.

PEN AND INK,. PENCIL, AND OTHER IMAGING

Introduction

Pen and ink, pencil, Xerox photocopying, and other imaging methods all have their own characteristics and advantages. Illustration No. 12 shows the characteristics of four imaging techniques as seen under a microscope.

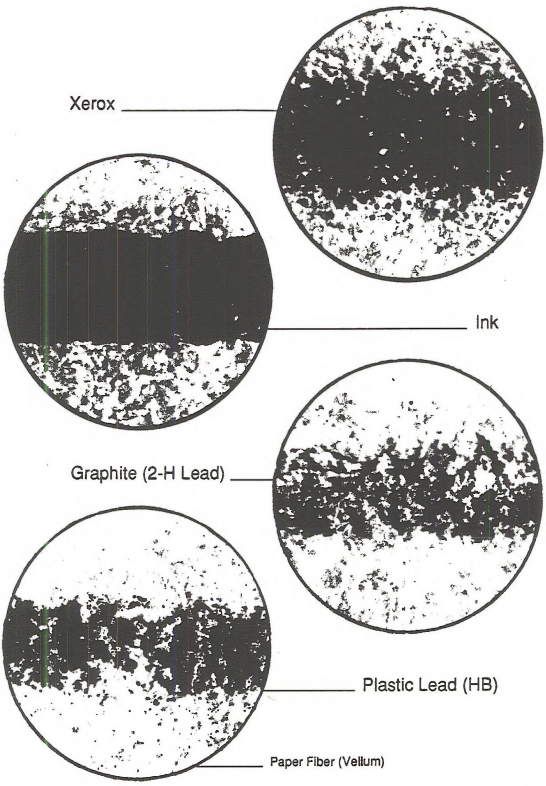
The preservationist in the Bureau may never be called upon to chemically identify any of the inks that were used on old documents (Table 4). However, preservationists should at least be able to identify simply by appearance the type of ink that they are working with, whether it be soluble and insoluble, iron gall ink or carbon ink, etc., since the type of ink may have a direct bearing on the preservation techniques used for the paper. The preservationist should also have a brief knowledge of other imaging materials, such as a cyanotype, or the salted print. This portion of the training is intended to fill in where heavy research would otherwise be required.

Even in prehistorical times, man found the need to record events and information. The paintings and chiseled pictures on cave walls bear witness to these needs. The coloring used on these pictures ranged from various colored clays and stains made from vegetative matter to human and animal excrements.

The earliest known writing was done on clay tablets. Later, thin sheets of lead or copper were used. Even thin slabs of wood coated with beeswax were once utilized as a writing surface.

Illustration 12

COMPARISON OF IMAGE LINES



Lines Enlarged 10 Times

TABLE 4

Identification of Writing Ink by Spot Testing

Reagent	Iron gall ink	Carbon ink	Logwood ink	Prussian Blue	Nigrosine	Colored ink with vanadium	Iron gall ink plus aniline color
Sodium hydroxide	dark red	NE	bleaches	NE	runs dark violet	bleaches	NE
Potassium ferrocyanide	blue	NE	red	NE	NE	NE	blue
Oxalic acid 3%	bleaches	NE	orange or violet	NE	NE	bleaches	
Sodium hypochlorite	bleaches	NE	bleaches	NE	brown	NE	bleaches
Citric acid 10%	dissolves	NE	violet or orange	NE	runs dk. blue	NE	blue
Stannous chloride 10%	bleaches	NE	red	NE	NE	bleaches	blue
Sodium chlorate 10%	dissolves	NE	dissolves	NE	NE	NE	dissolves
Thiocyanic acid	red	NE	NE	NE	NE	NE	red
Tartaric acid 10%	bleaches	NE	light brown	NE	runs dk. blue	bleaches	blue
Hydrochloric acid 10%	bleaches with yellow residue	NE	red	NE	NE	bleaches	blue
Nitric acid 10%	bleaches	NE	red	NE	NE	bleaches	blue
Potassium thiocyanate	red	NE	NE	NE	NE	NE	red

A small drop of the reagent listed in the left column will react with the inks listed across the top as indicated. (NE = no effect)

Most reagents must be neutralized after the test is completed.

The Egyptians are credited with the discovery of making a type of paper from the papyrus plant. Another, later form of writing material was parchment, which was made from animal skins.

The Chinese are credited with the invention of paper in or about the year 105 AD. The one common element for papyrus, parchment, and paper was that, instead of incising or gouging the letters or characters into the surface of the material, writing was done with inks and brushes on the surface.

Inks

Originally inks were nothing more than juices of plants mixed with water which would stain the writing material wherever it was applied. These "inks" usually had to be mixed daily from a sun-dried powder or cake, since, in the liquid form, they tended to decompose in a short time. Later it was found that gallic acid, a clear crystalline compound derived from tannin (galls on oak trees), would act as a preservative, allowing inks to be manufactured in premixed liquid form.

The need to write and draw with fine lines lead to the design of the pen. Tail and wing feathers of birds, when properly sharpened on the quill, were found to fill this need. The fine lines required that the density of the inks had to be increased to be able to be seen, so finely ground colored solids were added. The formulation of inks as we know them today has therefore come about because of better pen designs, along with improvements in the manufacture of paper and other drawing materials.

Inks used for drafting are becoming more specialized regarding the material they are to be used on, but all share the same general ingredients:

Toner - Microscopic particles of carbon are used to give a permanent black tone to the ink. The particles are so small that the movement of the molecules of the liquid carrier will keep the carbon particles suspended throughout the liquid. This is called a colloid suspension. Smoke in air is another example of a colloid suspension.

Liquid carrier - Usually water, as the drying speed is neither too fast nor too slow. Other additives in the solution can affect the rate at which the water will evaporate.

Binder - Even though the ink accumulates in the tooth of the drawing surface, the carbon particles need a substance that, when dry, will hold them in place. In permanent inks, this binder should not be readily redissolved in water.

Clearing agent - Until recently, sulphuric acid has been used as a clearing agent to remove unwanted residues from the ink solution. An overabundance of this acid will damage pens and, with the presence of ambient humidity, has been known to eat through the paper it was applied to. This, of course, happens over a long period of time.

Modern inks are using binders made specifically to adhere to plastics. Their formulation has also been changed so they have a lesser surface tension, allowing them to work better in technical pens as opposed to the older ruling pens and quill pens. Newer inks are being formulated with latex, which allows for better density of the lines more permanence. In these inks it is not necessary to have the acid clearing agent.

Any new type of ink should be inspected and then tested on the material(s) it will be used on before being used on an archival document. Note how much toner has settled out of the suspension by simply pouring (without preshaking) the contents of a randomly selected bottle into another clean container. As you pour, visually look for lumps or thick sludge. (The ink should pour freely.) Do not pour out the sludge. Set the emptied bottle on a level surface and allow it to stand for about a minute. With a clean, semi-absorbent dipstick (preferably hardwood) inserted vertically to touch the bottom of the bottle, the level of sludge/residue should not reach more than 1/16" up the stick. Also note whether the manufacturer guarantees or warrants that the ink is nonetching.

On a sample of the material to be inked, draw five lines about 3 inches long and 1/4 inch apart with a 1.00 mm pen. Allow the inked sample to set for about 15 minutes. With the aid of a measuring microscope or magniviewer eye loup, check for line density and ink spread. If this is satisfactory, use an artqum eraser and rub back and forth five times on one end of the lines. If there is no appreciable erasure, continue with the next test.

Wipe your hands on a clean paper towel. Then hold your hand in a soft fist for one minute. With your index finger, rub once, crosswise, through the center of the lines. You should see very little smudging. Any smudges present should be removable with an art gum eraser.

High-Tack tape testing should be done on resin-filled vellums, acetate films, polyester films, and resin-coated photographic paper. (Use 3M Scotch Brand Tape No. 610 or equivalent.) Simply press a piece of this tape onto the untested end of the lines and lift sharply. The tape will remove some of the inked image and, on paper products, could possibly lift some of the paper fiber. In any case, enough of the image should be left to be reproducible or photographable.

Permanent "India" inks should no longer be considered as universal. By inspection and testing, the best ink can be matched to the drafting material it will be used on.

Pencils

Pencil lead is not lead at all--it is graphite. The name "graphite," which comes from the Greek "Graphien," was not given to the mineral substance found in an outcrop near Borrowdale, England, in the year 1565 until about 200 years after its discovery. However, from the start, it was found that this mineral called "wad," "Black Lead," "black-cowke,"--and later as "plumbago," "kish," and "crayon noir"--was an excellent marking medium, and thus came the birth of the pencil. Traces of lead (hence the name that has lived through the centuries) and antimony are also found impregnated in graphite.

Graphite and diamonds are both allotropic forms of carbon.

No one knows what it was supposed to cure, but powered graphite was used as a medicine. At one time it was illegal to export graphite from England, except in the form of pencils, because it was found that its resistance to high temperatures made it perfect for casting cannon shells and for lining crucibles used to melt metal alloys such as brass. For many years England controlled the graphite market.

Pencil leads were cut directly from slabs of solid graphite, which left the manufacturer with a large amount of graphite powder that couldn't be used. The graphite deposits discovered in countries outside England could not be mined in slabs, so their usefulness was limited. Glue, sulphur, and other substances were experimentally tried as binders to hold powdered graphite together, none of which proved successful.

It wasn't until 1790 that an especially fine clay was found that provided the ideal binder. The proportion of clay to powdered graphite made it possible to manufacture pencil leads in different degrees of hardness; before this binding clay was used, the purity of the natural graphite deposits was the only determining factor for the hardness of the pencil lead and the density a line could be drawn.

Today there are 17 degrees of hardness to choose from:

Soft - 6B, 5B, 4B, 3B, 2B, B, HB, F, H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H-Hard

Graphite can now be mechanically produced from coal. However, where possible, pencil manufacturers are still using the natural mineral. Technology has taken pencil lead manufacturers a step farther; polymerized plastics are now replacing graphite for drawing on certain polyethylene materials, which requires a more dense line than is obtainable from graphite leads.

Other than paper that is self-destructing because of its acid content, faded inks and smeared pencil lines are probably the most critical problem that preservationists face in saving BLM's old records. There are methods that can enhance old inked images, including the use of chemical fumes and gases. However, many of these methods require the full facilities of a chemical laboratory and should not be attempted by the Bureau's preservationists. It has been found that smeared pencil lines can be enhanced on a photographic plate by using high contrast film and infrared film, up through infrared scanner techniques. If there are any questions on this subject, please contact the preservation officer at the Service Center.

REPRODUCTION

Throughout the Bureau, there are case files, books, and single documents with images that are not pen and ink, Xerox, typing, or pencil. The following listing will increase your awareness of these other reproduction media; before any work is done on them, contact the preservation officer at the Service Center.

At one time, the scribe was required to draw several duplicates of the original document so that the original became the "record", while the duplicates were used as the working copies. This duplicating method was slow and expensive and resulted in a large number of errors and omissions. It was not until the 1840s that an inexpensive method of duplicating was invented by Sir John Frederick William Herschel, thus allowing the scribe to go on to the next job rather than making copies. Herschel's process, for the most part, has become obsolete, but the name of his duplicating method is now being applied to newer reproduction methods.

Blue Print (Cyanotype) - Herschel

The blue print was originally made from drawings rendered on thin paper or translucent tracing cloth (linen soaked in starch, dried flat with a surface sizing, and dimensionally cut or processed into rolls). To make a print, the drawing was laid over a sensitized piece of blue print paper, clamped into a glass frame and exposed to the sun for about 5 minutes (depending on weather conditions). The blue print paper was commercially sensitized with a mixture of ammonium ferric citrate and potassium ferricyanide. Where the sensitized coating was protected by the shadow of the lines on the drawing, nothing would happen. Where light could penetrate to the chemical coating, the mixture would react to form a blue background. The "print" was washed in water and then immersed in a solution of potassium dichromate to intensify the blue color. Next, the print was washed again and laid out to dry. The resulting contact print was a reversal of the original, or negative in form; what on the original had been a black line on a white background, on the print would become a white line on a blue background. The prints, through time, have proved rather durable if they were properly processed.

Diazo

The photo properties of diazonium salts used in the synthesis of aniline dyes were put to use shortly after World War II. It was found that ultraviolet light would bleach some of these organic salts, while the introduction of the ammonium radical (NH_3) in liquid or gaseous form to the same unexposed salts would cause them to turn a dark color (Sepia or brown, blue, and black). When a coating of any of these salts is applied to films or papers, it can be used to make contact or shadow prints of an image drawn on a translucent material.

When a drawing master is placed over a sensitized diazo paper and properly exposed, the shadows of the lines protect the sensitized surface. Where light reaches the sensitized surfaces around the lines, the coating is bleached. When ammonia is applied to this surface, the unexposed image becomes visible; it is "developed." Therefore, the copy image is the same as the original (dark lines on light background). This is called "auto-positive" printing, meaning that it is not necessary to make an intermediate negative.

In the diazo process, there is a drop of about 12 percent from the density of the lines on the original compared to the lines on the copy. This is not significant when making first-generation paper prints for distribution, but when one considers making working records on film, each generation thereafter (a copy of a copy of a copy) becomes less dense. By the fifth generation, the line density is only about half of what the original was. Diazo reproduction machines are well suited for large volume printing of large drawings.

Photography

The most versatile of copying processes has been photography. Films or plates for image capture have been known since 1737, and through the years, photographic processes have improved to what we have today.

Contact films now used for graphics can be handled safely in a room illuminated by red lights, since they are almost insensitive to this band or frequency of light. The film is coated with crystals of silver bromide held in place by a thin layer of gelatin. When exposed to light, the crystals precipitate out as silver. The film is then immersed into a bath of developer made up of water, hydroquinone, Metol, sodium carbonate, and sodium sulphite. This solution accelerates the precipitation process. When the film is washed and moved to a bath of sodium thiosulphate or fixer, the unexposed crystals of silver bromide are dissolved, leaving clear areas in the film (clear lines with a black background, or a negative).

A second print (reversal either on paper or film) must be contacted from the negative to make a positive print. Photographic materials are also available in auto-positive format.

In the filming process, there is a 2 to 4 percent loss in density per generation. Because of the silver used in the filming processes, reproduction costs can become quite high.

Salted Print

Scattered among our records, especially our cadastral records, there are negative types of prints that look like used carbon paper, with white areas representing lines for the drawing or text. These documents are known as salted prints.

Salted prints resulted from an early process that was used especially on large documents. Papers were impregnated directly with silver salts; there is no emulsion on salted prints; the paper itself acts as the emulsion or binder. Prints were made by placing a translucent written or drawn page face down on the impregnated paper, exposing the image, and then developing using a regular photographic process. For the most part, the final rinse was of an alkaline nature, so salted prints need not be deacidified.

Salted prints can be replaced by contact printing with present day photographic papers, which are much more substantial than some of the older papers. Patch and repair techniques on papers of this type should be avoided. If there are any difficulties in reproducing salted prints onto photographic paper, please discuss this with the preservation officer at the Service Center.

Photostatic copies

Photostats developed around the 1900s became a way of inexpensively copying many types of documents. This was done using a camera and cheap paper that had a gelatin coating.

This reproduction method has many drawbacks. Because documents were photographed through a lens, they may be smaller or larger than the size of the original document. Photostatic filming was done on a production-line basis: exposures were frequently not dark enough and chemical solutions were not totally washed out of the papers. Images have now faded to a point where they are almost unreadable and impossible to photograph unless high resolution films are used to enhance the photostatic imagery.

Water can be very detrimental to this type of record. Recovery from water damage with this type of document should always be done by vacuum freeze drying.

In 1906, the General Land Office records in San Francisco were destroyed by the great earthquake and subsequent firestorm that raced through the city. The Land Office had to obtain photostatic copies of GLO records that were held by state and county entities. Many of these documents have since faded to the point where they are unusable. If there is difficulty in reproducing images from these copies, you may contact the preservation officer at the Service Center or the Micrographics group at the Service Center.

Electrostatic Printing

One of the newest technologies for copying is the electrostatic, or Xerox, printer. Bond papers, vellums, or films can be used, as no special coatings are needed. The surface of the copy material is charged in the

machine with static electricity. The image to be copied is then projected through lenses onto the surface. Where light strikes the surface of the material, the electricity is discharged. Where the lines of the projected image strike the surface, the charge holds. The copy material is then passed to a chamber where plasticized carbon beads are attracted to the charged areas. The copy is next passed through a heater, which melts the beads; when cooled, these fused beads form permanent lines similar to ink lines.

New, large format machines offer enlargement and reduction features. All permanent documents must be reproduced on acid-free paper specifically made for these machines.

FILM

The subject of recovering film from a disaster is well covered in BLM Manual Section H-1273-1. Many of the techniques listed can also apply to separate films. Within the Bureau's holding of films, there are several types of film that you should be able to identify.

Types of Film

First, and going back to around 1942, were the nitrate films. These films will burn readily and can spontaneously ignite if they begin to break down. To test for nitrate films, cut a small strip from the edge of the film and touch it with a flame; if it bursts into flame, it is nitrate.

Later on, the film manufacturers turned to the acetate films. These films degenerate after long periods of time. If you have this type of film, and you see the degeneration, you should have it duplicated onto polyester film.

Next came diacetate film. Diacetate does degenerate, but not as fast as the acetate. Then came triacetate. Triacetate films are what are being used now in the photographic process. They are much clearer than the polyester films; however, of all the films, the most safest, most stable are the polyesters.

Testing for these different types of films is covered in the 1200-4 training course, which you, as custodians of film records, should take. But remember, above all, that any nitrate films or negatives should be copied onto newer film types, such as polyester. The originals should then be taken out and/or destroyed so they won't start a fire in your records area.

Proper Care of Film

It is important to know that films such as our microfilm holdings can be attacked by the creeping disaster, so you must check them occasionally. In a humid area, microfilms are susceptible to mildew. Mildew occurs as tiny spots. If you still have the original document, you can take the film chip, from, say, a CDI card, and immerse it in water, but inspect it first with a magnifying glass, and you will see a little mottled effect where the mildew has eaten. Swish this film chip in water, and, if the spots wash away, then it is mildew.

If mildew is present, then 1/2" strips of thymol paper can be inserted into the film drawers and the drawers closed for about a day. Also, if it is still available, refilm the original document to replace the card that you have tested. Never store the original film in the same area as the diazo copies. The ammonia from the diazo copies can attack the original films.

Fumes from paint will attack silver halide films. It has been found that small round spots will appear on the film, and the film, instead of being black, will take on a brownish color where the paint fumes have attacked it. This comes from not removing master film cabinets from an area being painted, and keeping them out of the area until the paint has dried. Moving film cabinets may seem like an extra expense. However, whole holdings of roll film, jacketed film, and aperture cards have been damaged by paint fumes, requiring the refilming of all of the paper masters!

Remember also that microfilm is an irreversible image of the master. If the master paper copy is no longer available, then the microfilm image becomes the best available copy. If this image is destroyed, then we have lost a vital record. If you have any questions, contact the preservation officer at the Service Center.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Many of the older reference books mention certain names of chemicals that were used in the manufacture of paper, adhesives, and inks, and are now out of date and unknown to the modern chemist or conservator. Different industrial uses caused various names to be applied to the same chemical. Therefore, the following information is listed alphabetically both by old name/current name and by current name/old name, along with the correct symbol or formula, in order to provide the conservator doing research a translation of these names into modern terms so that proper preservation techniques can be applied without jeopardizing the chemical integrity of the documents. Always consult the latest Materials Safety Data Sheet (MSDS) before attempting to use any of these chemical products.

Old Name	Common/Current Name	Formula
Acid Potassium Sulphate	Potassium Bisulfate	$KHSO_4$
Acid of Sugar	Oxalic Acid	$H_2C_2O_4$
Alcali Volatil	Ammonium Hydroxide	NH_4OH
Alcohol Sulphuris	Carbon Disulfide	CS_2
Alum (Potassium)	Potassium Aluminum Sulphate	$K_2SO_4.Al_2(SO_4)_3.24H_2O$
Alumina	Aluminum Hydroxide	$Al(OH)_3$
Aluminum	Aluminum	Al
Ammonia (anhydrous)	Ammonia (gas)	NH_3
Antimony Black	Antimony Trisulfide	Sb_2S_3
Antimony Bloom	Antimony Trioxide	Sb_2O_3
Antimony Glance	Antimony Trisulfide	Sb_2S_3
Antimony Red	Antimony Oxysulfide	$SbOS_3$
Antimony Vermilion	Antimony Oxysulfide	$SbOS_3$
Aqua Fortis	Nitric Acid	HNO_3
Aqua Regia	Nitro Hydrochloric Acid	$HNO_3.HCl$
Argentum	Silver	Ag

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Old Name	Common/Current Name	Formula
Aurum	Gold	Au
Baking Soda	Sodium Bicarbonate	$NaHCO_3$
Beryllium	Beryllium	Be
Bisemutum	Bismuth	Bi
Bitter Salt	Magnesium Sulfate	$MnSO_4$
Blue Copperas	Copper Sulfate	$CuSO_4$
Blue Salts	Nickel Sulfate	$NiSO_4$
Blue Stone/Blue Vitriol	Copper Sulfate	$CuSO_4$
Bone Ash	Impure Calcium Carbonate	$CaCO_3$
Bone Black	Animal Charcoal	C
Brimstone	Sulfur	S
Butter of Antimony	Antimony Trichloride	$SbCl_3$
Butter of Tin	Stannic Chloride Hydrated	$SnCl_4.5H_2O$
Butter of Zinc	Zinc Chloride	ZnCl
Cadmium	Cadmium	Cd
Calomel	Mercurous Chloride	Hg_2Cl_2
Carbolic	Carbolic Acid	C_6H_5OH
Carbon	Carbon	C
Caustic Soda	Sodium Hydroxide	NaOH
Chile Nitre	Sodium Nitrate	$NaNO_3$
Chile Saltpeter	Sodium Nitrate	$NaNO_3$
Chromic Acid	Chromium Trioxide	CrO_3
Chromium	Chromium	CR
Cobalt	Cobalt	Co

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Old Name	Common/Current Name	Formula
Collodian	Pyroxylin	$(CH_3)_3C_5H_2N$
Common Salt	Sodium Chloride	NaCl
Copperas (Iron Sulfate)	Ferrous Sulfate	$FeSO_4$
Corrosive Sublimate	Mercuric Chloride	$HgCl_2$
Corundum	Aluminum Oxide	Al_2O_3
Cuprum	Copper	Cu
Ethanol	Ethyl Alcohol	CH_3CH_3OH
Ferro Prussiate	Potassium Ferricyanide	$KaFe(CN)_6$
Ferrum	Iron	Fe
Flaxseed Oil	Linseed Oil	Vegetable oil (Natural) CAS Reg. # 8001-26-1
Flores Martis	Anhydrous Ferric Chloride	$FeCl_3$
Flowers of Sulfur	Sulfur	S
Gallic Acid	3, 4, 5, Trihydroxybenzoic Acid	$C_7H_6O_5$
Grain Alcohol	Ethyl Alcohol	CH_3CH_3OH
Grain Vitriol	Ferrous Sulfate	$FeSO_4$
Green Vitriol	Ferrous Sulfate	$FeSO_4$
Household Bleach	Sodium Hypochlorite	NaClO
Hypo (Sodium Hyposulfite)	Sodium Thiosulfate	$Na_2S_2O_3.5H_2O$
Iron Perchloride	Ferric Chloride	$FeCl_3$
Iron Pernitrate	Ferric Nitrate	$Fe(NO_3)_3$
Iron Protochloride	Ferrous Chloride	$FeCl_2$
Iron Persulphate	Ferric Sulfate	$Fe_2(SO_4)_3$
Jeweler's Etchant	3g. Silver Nitrate + 3 g. Nitric Acid + 3 g. Mercurous Nitrate + 100cc Water	$AgNO_3$ + HNO_3 + $HgNO_3.H_2O$ + H_2O

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Old Name	Common/Current Name	Formula
Kalium	Potassium	K
Killed Spirits	Zinc Chloride	ZnCl
K.N.S. Solution	10g. Ammonium Carbonate + 20g. Ammonium Peroxydisulfide + 200cc Ammonium Hydroxide	$(NH_4)_2CO_3$ + $(NH_4)_2S_2O_8$ + $NH_4OH.H_2O$
Lime	Calcium Oxide	CaO
Liver of Sulphur	Melted Potassium Carbonate + Sulfur.	$KClO_3$ + S
Lunar Caustic	Silver Nitrate (Toughened).	$AgNO_3$
Magnesia	Magnesium	Mg
Manganese	Manganese	Mn
Methanol	Methyl Alcohol	CH_3OH
Molybdenum	Molybdenum	Mo
Muriate of Mercury	Mercuric Chloride	$HgCl_2$
Muriatic Acid	Hydrochloric Acid	HCl
Natrium	Sodium	Na
Nickel	Nickel	Ni
Nitre	Potassium Nitrate	KNO_2
Nitre	Sodium Nitrate	$NaNO_2$
Nitrate of silver	Silver Nitrate	$AgNO_3$
Nordhausen Acid	Fuming Sulfuric Acid	$H_2SO_4SO_3$
Oil of Mars	Deliquescent Anhydrous Ferric Chloride	$FeCO_3$
Oil of Vitriol	Sulfuric Acid	H_2SO_4
Orthophosphoric Acid	Phosphoric Acid	H_3PO_4
Oxymuriate of Mercury	Mercuric Chloride	$HgCl_2$
Oxymuriate of Potassium	Potassium Chlorate	$KClO_3$

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Old Name	Common/Current Name	Formula
Pearl Ash	Potassium Carbonate	K_2CO_3
Phosphorus	Phosphorus	P
Photographic Fix	See Sodium Thiosulfate or Hypo	$Na_2S_2O_3.5H_2O$
Plumbago	Graphite	C
Plumbum	Lead	Pb
Potash	Potassium Carbonate	$KClO_3$
Chrome Salt	Potassium Chromate	K_2CrO_4
Prussic Acid	Hydrocyanic Acid	HCN
Purple Crystals	Potassium Permanganate	$KMnO_4$
Quicksilver	Mercury (Hydrargyrum)	Hg
Red Prussiate of Potash	Potassium Ferricyanide	$KaFe(CN)_6$
Sal Ammoniac	Ammonium Chloride	NH_4Cl
Salts of Lemon	Potassium Acid Oxalate, 5% solution	$KHC_2O_4.H_2O$
Salts of Sorrol	Potassium Acid Oxalate, 5% solution	$KHC_2O_4.H_2O$
Salt of Tartar	Potassium Carbonate	K_2CO_3
Salt of Vitriol	Zinc Sulfate	$ZnSO_4$
Salt of Wormwood	Potassium Carbonate	K_2CO_3
Saltpeter	Potassium Nitrate	KNO_3
Sal Volatile	Ammonium Carbonate	$(NH_4)_2CO_3$
Slaked Lime	Calcium Hydroxide	$Ca(OH)_2$
Salts of Hartshorn	Ammonium Carbonate	$(NH_4)_2CO_3$
Soda	Sodium Carbonate	Na_2CO_3
Soot	Carbon	C
Spencer's Acid	3g Silver Nitrate + 3g. Nitric Acid + 3g. Mercurous Nitrate + 100cc Water	$AgNO_3$ + HNO_3 + $HgNO_3.H_2O$ + H_2O

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Old Name	Common/Current Name	Formula
Spirits of Hartshorn	Ammonium Hydroxide	$NH_4OH.H_2O$
Spirits of Salt	Hydrochloric Acid	HCl
Spirit of Nitrous Ether	Ethyl Nitrite	C_2H_5ONO
Spirits of Wine	Ethyl Alcohol	C_2H_5OH
Stannum	Tin	Sn
Stibnite	Antimony	Sb
Sugar of Lead	Lead Acetate	$Pb(CH_3CO_2)_2$
Sulphuric Ether	Ethyl Ether	$C_2H_5OC_2H_5$
Sweet Spirits of Nitre	Ethyl Nitrite Spirit	$C_2H_5ONO.CH_3CH_2OH$
Tannin	Tannic Acid	$C_{14}H_{10}O_9$
Tetrachloromethane	Carbon Tetrachloride	CCl_4
Tincture of Ferric Chloride.	Ferric Chloride + Ethyl Alcohol	$FeCl_3$ + CH_3CH_2OH
Tincture of Steel	Ferric Chloride + Ethyl Alcohol	$FeCl_3$ + CH_3CH_2OH
Tin Salt	Stannous Chloride	$SnCl_2$
Vanadium	Vanadium	V
Verdigris	Copper Acetate	$Cu(C_2H_3O_2)_2.H_2O$
Vitriol	Sulfuric Acid	H_2SO_4
Water Glass	Sodium Silicate	Na_2SiO_3
Whiting	Calcium Carbonate	$CaCO_3$
Wolfram	Tungsten	W
Wood Alcohol	Methyl Alcohol	CH_3OH
Yellow Prussiate of Potash	Potassium Ferrocyanide	$K_4Fe(CN)_6.3H_2O$
Zinc	Zinc	Zn

RECIPES, FORMULÁS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Aluminum	Aluminum	Al
Aluminum Hydroxide	Alumina	$Al(OH)_3$
Aluminum Oxide	Corundum	Al_2O_3
Ammonia	Ammonia (anhydrous)	NH_3
10g. Ammonium Carbonate + 20g. Ammonium Peroxydisulfide + 200cc Ammonium Hydroxide	K.N.S. Solution	$(NH_4)_2CO_3$ + $(NH_4)_2S_2O_8$ + $NH_4OH.H_2O$
Ammonium Carbonate	Sal Volatile	$(NH_4)_2CO_3$
Ammonium Carbonate	Salts of Hartshorn	$(NH_4)_2CO_3$
Ammonium Chloride	Sal Ammoniac	NH_4Cl
Ammonium Hydroxide	Alcali Volatil	NH_4OH
Ammonium Hydroxide	Spirits of Hartshorn	$NH_4OH.H_2O$
Anhydrous Ferric Chloride	Flores Martis	$FeCl_3$
Animal Charcoal	Bone Black	C
Antimony	Stibnite	Sb
Antimony Oxysulfide	Antimony Red	$SbOS_3$
Antimony Oxysulfide	Antimony Vermilion	$SbOS_3$
Antimony Trichloride	Butter of Antimony	$SbCl_3$
Antimony Trioxide	Antimony Bloom	Sb_2O_3
Antimony Trisulfide	Antimony Black	Sb_2S_3
Antimony Trisulfide	Antimony Glance	Sb_2S_3
Beryllium	Beryllium	Be
Bismuth	Bisemutum	Bi

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Cadmium	Cadmium	Cd
Calcium Carbonate	Whiting	$CaCO_3$
Calcium Hydroxide	Slaked Lime	$Ca(OH)_2$
Calcium Oxide	Lime	CaO
Carbolic Acid	Carbolic	C_6H_5OH
Carbon	Carbon	C
Carbon	Soot	C
Carbon Disulfide	Alcohol Sulphuris	CS_2
Carbon Tetrachloride	Tetrachloromethane	CCl_4
Chromium	Chromium	CR
Chromium Trioxide	Chromic Acid	CrO_3
Cobalt	Cobalt	Co
Copper	Cuprum	Cu
Copper Acetate	Verdigris	$Cu(C_2H_3O_2)_2.H_2O$
Copper Sulfate	Blue Copperas	$CuSO_4$
Copper Sulfate	Blue Stone/Blue Vitriol	$CuSO_4$
Deliquescent Anhydrous Ferric Chloride	Oil of Mars	$FeCO_3$
Ethyl Alcohol	Ethanol	CH_3CH_3OH
Ethyl Alcohol	Grain Alcohol	CH_3CH_3OH
Ethyl Alcohol	Spirits of Wine	C_2H_5OH
Ethyl Ether	Sulphuric Ether	$C_2H_5OC_2H_5$
Ethyl Nitrite	Spirit of Nitrous Ether	C_2H_5ONO
Ethyl Nitrite Spirit	Sweet Spirits of Nitre	$C_2H_5ONO.CH_3CH_2OH$
Ferric Chloride + Ethyl Alcohol	Tincture of Ferric Chloride	$FeCl_3$ + CH_3CH_2OH

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Ferric Chloride + Ethyl Alcohol	Tincture of Steel	$FeCl_3$ + CH_3CH_2OH
Ferric Chloride	Iron Perchloride	$FeCl_3$
Ferric Nitrate	Iron Pernitrate	$Fe(NO_3)_3$
Ferric Sulfate	Iron Persulphate	$Fe_2(SO_4)_3$
Ferrous Chloride	Iron Protochloride	$FeCl_2$
Ferrous Sulfate	Copperas (Iron Sulfate)	$FeSO_4$
Ferrous Sulfate	Grain Vitriol	$FeSO_4$
Ferrous Sulfate	Green Vitriol	$FeSO_4$
Fuming Sulfuric Acid	Nordhausen Acid	$H_2SO_4SO_3$
Gold	Aurum	Au
Graphite	Plumbago	C
Hydrochloric Acid	Muriatic Acid	HCl
Hydrochloric Acid	Spirits of Salt	HCl
Hydrocyanic Acid	Prussic Acid	HCN
Impure Calcium Carbonate	Bone Ash	$CaCO_3$
Iron	Ferrum	Fe
Lead	Plumbum	Pb
Lead Acetate	Sugar of Lead	$Pb(CH_3CO_2)_2$
Linseed Oil	Flaxseed Oil	Vegetable oil (Natural) CAS Reg. # 8001-26-1
Magnesium	Magnesia	Mg
Magnesium Sulfate	Bitter Salt	$MnSO_4$
Manganese	Manganese	Mn
Melted Potassium Carbonate + Sulfur.	Liver of Sulphur	$KClO_3$ + S

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Mercuric Chloride	Corrosive Sublimate	$HgCl_2$
Mercuric Chloride	Muriate of Mercury	$HgCl_2$
Mercuric Chloride	Oxymuriate of Mercury	$HgCl_2$
Mercurous Chloride	Calomel	Hg_2Cl_2
Mercury (Hydrargyrum)	Quicksilver	Hg
Methyl Alcohol	Methanol	CH_3OH
Methyl Alcohol	Wood Alcohol	CH_3OH
Molybdenum	Molybdenum	Mo
Nickel	Nickel	Ni
Nickel Sulfate	Blue Salts	$NiSO_4$
Nitric Acid	Aqua Fortis	HNO_3
Nitro Hydrochloric Acid	Aqua Regia	$HNO_3.HCl$
Oxalic Acid	Acid of Sugar	$H_2C_2O_4$
Phosphoric Acid	Orthophosphoric Acid	H_3PO_4
Phosphorus	Phosphorus	P
Potassium	Kalium	K
Potassium Acid Oxalate, 5% solution	Salts of Lemon	$KHC_2O_4.H_2O$
Potassium Acid Oxalate, 5% solution	Salts of Sorrol	$KHC_2O_4.H_2O$
Potassium Aluminum Sulphate	Alum (Potassium)	$K_2SO_4.Al_2(SO_4)_3.24H_2O$
Potassium Bisulfate	Acid Potassium Sulphate	$KHSO_4$
Potassium Carbonate	Pearl Ash	K_2CO_3
Potassium Carbonate	Potash	$KClO_3$
Potassium Carbonate	Salt of Tartar	K_2CO_3
Potassium Carbonate	Salt of Wormwood	K_2CO_3

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Potassium Chlorate	Oxymuriate of Potassium	$KClO_3$
Potassium Chromate	Chrome Salt	K_2CrO_4
Potassium Ferricyanide	Ferro Prussiate	$KaFe(CN)_6$
Potassium Ferricyanide	Red Prussiate of Potash	$KaFe(CN)_6$
Potassium Ferrocyanide	Yellow Prussiate of Potash	$K_4Fe(CN)_6.3H_2O$
Potassium Nitrate	Nitre	KNO_2
Potassium Nitrate	Saltpeter	KNO_3
Potassium Permanganate	Purple Crystals	$KMnO_4$
Pyroxylin	Collodian	$(CH_3)_3C_5H_2N$
Silver	Argentum	Ag
3g. Silver Nitrate + 3 g. Nitric Acid + 3 g. Mercurous Nitrate + 100cc Water	Jeweler's Etchant	$AgNO_3$ + HNO_3 + $HgNO_3.H_2O$ + H_2O
Silver Nitrate	Nitrate of silver	$AgNO_3$
3g Silver Nitrate + 3g. Nitric Acid + 3g. Mercurous Nitrate + 100cc Water	Spencer's Acid	$AgNO_3$ + HNO_3 + $HgNO_3.H_2O$ + H_2O
Silver Nitrate (Toughened)	Lunar Caustic	$AgNO_3$
Sodium	Natrium	Na
Sodium Bicarbonate	Baking Soda	$NaHCO_3$
Sodium Carbonate	Soda	Na_2CO_3
Sodium Chloride	Common Salt	NaCl
Sodium Hydroxide	Caustic Soda	NaOH
Sodium Nitrate	Chile Nitre	$NaNO_3$
Sodium Nitrate	Chile Saltpeter	$NaNO_3$
Sodium Nitrate	Nitre	$NaNO_2$
Sodium Silicate	Water Glass	Na_2SiO_3

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

Common/Current Name	Old Name	Formula
Sodium Hypochlorite	Household Bleach	NaClO
Sodium Thiosulfate	Hypo (Sodium Hyposulfite)	$Na_2S_2O_3.5H_2O$
Sodium Thiosulfate	Photographic Fix	$Na_2S_2O_3.5H_2O$
Stannic Chloride Hydrated	Butter of Tin	$SnCl_4.5H_2O$
Stannous Chloride	Tin Salt	$SnCl_2$
Sulfur	Brimstone	S
Sulfur	Flowers of Sulfur	S
Sulfuric Acid	Oil of Vitriol	H_2SO_4
Sulfuric Acid	Vitriol	H_2SO_4
Tannic Acid	Tannin	$C_{14}H_{10}O_9$
3, 4, 5, Trihydroxybenzoic Acid	Gallic Acid	$C_7H_6O_5$
Tin	Stannum	Sn
Tungsten	Wolfram	W
Vanadium	Vanadium	V
Zinc	Zinc	Zn
Zinc Chloride	Butter of Zinc	ZnCl
Zinc Chloride	Killed Spirits	ZnCl
Zinc Sulfate	Salt of Vitriol	$ZnSO_4$

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

STAINS

The following are examples of some of the old chemicals and recipes used for coloring. Inks and book covers either used the natural color of the chemical, or the chemical was reacted with other chemicals to form the desired dyestuff. (See "Conservation of Library Materials," Cunha, The Scarecrow Press, Metuchen, N.J., Page 42.)

NATURAL STAINS

Name	Chemical Compound
Alkanet Root	Alkanna tinctoria
Asphaltum	Mixture of natural bitumins & asphalt
Dragon's blood	Resin extracted from the fruit of the malayan rattan palm
Fustic	Pulverized dried sumac leaves
Logwood	Haematoxylin

CHEMICAL STAINS

Name	Chemical Compound
Verdigris	Cupric acetate
Madder	Acid alizarine blue
Pearlash	Potassium carbonate anhydrous
Soot	Carbon
Common soda	Bicarbonate
Purple crystals	Potassium permanganate

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

CHEMICALS

When coloring metals, the chemical was used to modify the color by directly reacting with the surface of the metal, as shown in these old recipes. Note the use of the old chemical names.

Giving Brass a Green Tint. -- One solution that will produce the verde antique, or rust green, is composed of 3 ounces crystallized iron perchloride, 1 pound sal ammoniac, 8 ounces verdigris, 10 ounces common salt, 4 ounces potassium bitartrate, and 1 gallon of water. If the objects to be colored are large, the solution can be put on with a brush. Several applications may be required to give the desired depth of color. Small work should be immersed; the length of time it remains in the solution will govern the intensity of the color.

Niter Process of Bluing Steel. -- The niter process of bluing iron and steel is as follows: The niter or nitrate of potash is melted in an iron pot and heated to about 600 degrees F. The parts to be blued are cleaned and polished and then immersed in the molten niter until a uniform color of the desired shade has been obtained. This requires only a few seconds. The articles are then removed and allowed to cool, after which the adhering niter is washed off in water. Parts which will not warp may be immersed immediately after removing from the niter bath. After cleaning, dry the metal parts in sawdust and then apply some suitable oil, such as linseed, to prevent rusting. To secure uniform coloring, a pyrometer should be used to gauge the temperature of the niter; a heat higher than 600 degrees F. will produce a dark color, whereas a lower heat will give a lighter shade.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

GLOSSARY OF TERMS USED ON

MATERIAL SAFETY DATA SHEETS (MSDSs), AND RELATED TERMS

ACGIH -- American Conference of Governmental Industrial Hygienists.

ACUTE -- An adverse effect on the human body with symptoms of high severity coming quickly to a crisis.

BP -- Boiling point at 1 atmosphere (atm) expressed in degrees Fahrenheit (°F).

CAG -- Carcinogen Assessment Group.

CAS NUMBERS -- Chemical Abstract Service registry numbers. This number is unique for each chemical and allows more efficient searching on other data bases such as the Chemical Substances Information Network (CSIN).

CATALYST -- A chemical that changes the rate of a chemical reaction between two other chemicals being without affected chemically itself.

CHRONIC -- An adverse effect on the human body with symptoms that develop slowly over a long period of time or which frequently recur.

COLLAGEN -- The principal constituent of the fiber-network layer of hides and skins used in producing leather. It is the protein substance that is the most important part of the connective tissue of animals. When boiled in water, collagen undergoes partial hydrolysis, which yields gelatin.

COMPOUND -- Combining two or more elements to form a chemical substance.

CSIN -- Chemical Substances Information Network.

DOT -- Department of Transportation.

ELEMENT -- A basic substance that cannot be further broken down chemically.

EPA -- Environmental Protection Agency.

EVAPORATION RATE -- A measure of the length of time required for a given amount of a substance to evaporate, compared with the time required for an equal amount of ether or butyl acetate to evaporate.

EXPLOSIVE LIMITS -- See Flammable Limits; LEL; UEL.

FEMA NUMBER -- Identification number assigned to a chemical product by the Federal Emergency Management Agency.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

GLOSSARY OF TERMS USED ON

MATERIAL SAFETY DATA SHEETS (MSDSs), AND RELATED TERMS

FILLER -- A substance used to attain fiber bonding and desired finishes on the surface of paper, or a substance added as an extender to adhesives. Fillers can also be called "sizing".

FLAMMABLE (INFLAMMABLE) -- The property of a product to be easily ignitable and capable of burning with great rapidity.

FLAMMABLE LIMITS -- (Explosive Limits)

(LEL) Lower Flammable (Explosive) Limit -- The lowest concentration of a combustible or flammable gas or vapor in air that will produce a flash of fire. Mixtures below this concentration are too "lean" to burn.

(UEL) Upper Flammable (Explosive) Limit -- The highest concentration of a combustible or flammable gas or vapor in air that will produce a flash of fire. Mixtures above this concentration are too "rich" to burn.

FLASH POINT -- The lowest temperature at which the vapor of a combustible liquid can be made to ignite momentarily in air.

FL.P -- Flash point, closed cup, expressed in degrees Fahrenheit (°F) (or open cup if annotated "oc") vapor pressure at 20° Centigrade (C), mmHg.

GESSO -- A preparation of plaster of Paris and glue used as a base for applying other materials to a surface. Also used as a filler with adhesives.

HYDROLYSIS -- The decomposition of a chemical compound by reaction with water.

IARC -- International Agency for Research on Cancer.

IDLH -- The Immediately Dangerous to Life or Health level which represents a maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

INFLAMMABLE -- See "FLAMMABLE".

INGESTION -- The taking in of a substance through the mouth.

INHIBITOR -- A chemical that is added to another substance to prevent an unwanted chemical change from occurring.

ION -- An atom, group of atoms, or molecule that has gained an electric charge ($\pm$) by gaining or losing electrons from an initially electrically natural configuration. This process is known as "Ionization".

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

GLOSSARY OF TERMS USED ON

MATERIAL SAFETY DATA SHEETS (MSDSs), AND RELATED TERMS

IP -- Ionization Potential.

LAVAGE -- Pumping the stomach.

LEL -- Lower explosive limit in air expressed as a percentage by volume.

MEC -- Minimum explosive concentration for a dust in air.

MIXTURE -- The combination of two or more elements or compounds to form a desired substance. The materials in mixtures do not chemically interact with each other.

MP -- Melting point, in degrees Fahrenheit (°F).

MSDS -- Materials Safety Data Sheet.

MW -- Molecular weight.

NIOSH -- National Institute for Occupational Safety and Health.

NONFLAMMABLE -- The inability to ignite under normal conditions.

NTIS -- National Technical Information Service.

NTP -- National Toxicology Program.

ORAL DOSE (LD_{50}) -- The amount of a substance taken by mouth that would kill within 14 days half (50 percent) of those exposed. The dose is measured in milligrams per kilogram of body weight of the test animal. Also known as lethal dose.

OSHA -- Occupational Safety and Health Administration.

OXIDIZE -- To combine with oxygen.

OXIDIZING AGENT -- A substance that oxidizes by taking up electrons, or a chemical that gives off free oxygen in a chemical reaction. (See reducing agent.)

PEL -- The permissible exposure limit over an 8-hour time-weighted average to which any employee may be exposed.

POLYMERIZATION -- A chemical reaction in which two or more small molecules combine to form larger molecules.

PPM -- Parts per million.

REACTIVITY -- A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

REDUCTION -- To give up oxygen in a chemical reaction.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

GLOSSARY OF TERMS USED ON

MATERIAL SAFETY DATA SHEETS (MSDSs), AND RELATED TERMS

REDUCING AGENT -- A substance that reduces by donating or sharing electrons with another substance, or a chemical that absorbs oxygen in a chemical reaction.

RESIN -- A substance derived from plants or synthesized that is hard, brittle, clear to translucent, and either solid or semisolid. Resins are used as fillers or stabilizers in the manufacture of paper. These products are insoluble in water and soluble in organic solvent.

ROSIN -- The refined product obtained from the resin or gum of the southern pine. Rosin is essentially an organic acid that must be converted by the addition of alum before it can be used as a water-resistant sizing in the manufacture of paper.

SCP -- Standards Completion Program; jointly developed by NIOSH and OSHA.

SOL -- Solubility in water expressed as grams per 100 grams of water at 20°C.

SOLUBILITY -- A measure of the amount of a substance that will dissolve in a given amount of water or other solvent.

SPECIFIC GRAVITY -- The ratio of the mass of a solid or liquid to the mass of an equal volume of distilled water at 4°C, or of a gas to an equal volume of air or hydrogen under prescribed conditions of temperature and pressure.

SPONTANEOUS HEATING -- An increase in the internal temperature of a substance due to a chemical or physical change without the application of external heat.

STABILITY -- A measure of the ability of a substance to be handled and stored without undergoing unwanted chemical changes.

SUBLIMATE -- To cause a solid or gas to change state without becoming a liquid.

SUPERNATANT -- Floating on the surface.

THERMAL DECOMPOSITION -- Chemical breakdown of a material brought about by exposure to heat.

THRESHOLD LIMIT VALUES -- The airborne concentrations of substances that nearly all workers can be repeatedly exposed to day after day without adverse effects.

TLV -- Threshold limit values.

TLV-TWA -- The time-weighted average (TWA) concentration for a normal 8-hour workday and a 40-hour work week to which nearly all workers can be repeatedly exposed, day after day, without adverse effect.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

GLOSSARY OF TERMS USED ON

MATERIAL SAFETY DATA SHEETS (MSDSs), AND RELATED TERMS

TOXICITY -- The measure of the adverse effect exerted on the human body by a poisonous material.

TSCA -- Toxic Substances Control Act.

UEL -- Upper explosive limit in air expressed as a percentage by volume.

VALENCE -- The capacity of an atom or group of atoms to combine in specific proportions with other atoms or groups of atoms as found in oxidation/reduction reactions.

VAPOR PRESSURE -- The pressure created by a vapor in equilibrium with its solid or liquid phase.

VOLATILE -- Evaporating readily at normal temperatures and pressures.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

HOW TO READ A MATERIALS SAFETY DATA SHEET (MSDS)

DEFINITIONS

This definition page is intended for use with Materials Safety Data Sheets supplied by the source chemical company. Questions concerning these sheets should be directed to the Environmental and Occupational Safety Department.

SECTION I - PRODUCT IDENTIFICATION

Product Class: General or generic identification.

Hazardous Classification: Product meets Department of Transportation (DOT) criteria for hazards listed.

SECTION II - HAZARDOUS COMPONENTS

A hazardous ingredient is one which meets one or more of the following criteria:

1. It is listed in the Annual Registry of Toxic Effects of Chemical Substances, or it is known to be toxic within the parameters of that Registry.

AND/OR

2. It has an OSHA established, 8-hour time-weighted average permissible exposure limit (PEL) or acceptable ceiling (C), or an American Conference of Governmental Industrial Hygienists' (ACGIH) threshold limit value, and by nature of the product or its known use, it is likely to become airborne.

AND/OR

3. It contributes to one or more of the following hazards of the product:

   A. Flashpoint below 200 deg F. closed cup (cc), or subject to spontaneous heating or decomposition.

   B. Causes skin burns. (DOT)

   C. Strong oxidizing agent. (DOT)

   D. Subject to hazardous polymerization.

Each ingredient meeting one or more of the above criteria is listed in Section II if present at a level at least greater than one percent. Ingredients which are claimed to be carcinogens, teratogens, mutagens, or causative agents of other reproductive disorders are listed if known or believed to be present, provided that the data supporting such claims is considered valid.

Each hazardous ingredient is listed by chemical, generic, or proprietary name. Its level in the product is expressed as 1% or less, 1 to 10%, 10 to 30%, 30 to 60%, or greater than 60%, or by other means.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

HOW TO READ A MATERIALS SAFETY DATA SHEET (MSDS) (Continued)

SECTION III - PHYSICAL DATA

Initial Boiling Point: If material is a liquid at 68 deg F.

Vapor Pressure: If material is a liquid at 68 deg F. or if it sublimates at this temperature.

Vapor Density: For volatile portion of product.

Specific Gravity: If specific gravity of product is not known, indicated as <1, $=1$, or >1.

Percent Volatiles: Percentage of material with initial boiling point below 425 deg. F.

Evaporation Rate: Indicated as faster or slower than ethyl ether, unless stated.

SECTION IV - FIRE AND EXPLOSION HAZARDS

Flash Point: Closed cup.

Lower Explosion Limit (LEL): Indicated for component with lowest value.

Hazardous Decomposition Products: Known hazardous products resulting from heating, burning, etc., or reacted raw materials which may arise through heating, burning, etc.

Special Firefighting Procedures: Indicates equipment to protect firemen from toxic products of combustion or if water is not to be used.

Unusual Fire and Explosion Hazards: Hazards not covered by other sections of this report are shown here.

SECTION V - HEALTH HAZARD DATA

Recipients of this data sheet should consult the OSHA Safety and Health Standards (29 CFR 1910), particularly Subpart G - Occupational health and Environmental Control, and Subpart I - Personal Protective Equipment, for general guidance on control of potential occupational health hazards.

Permissible Exposure Level: OSHA established PEL -- if none available, an adopted value.

Effects of Overexposure: Given in general terms, local and systemic effects to the eyes, skin, or lungs if material is inhaled, unless not applicable due to physical form of product.

RECIPES, FORMULAS, AND PRESERVATION TECHNIQUES TRAINING

HOW TO READ A MATERIALS SAFETY DATA SHEET (MSDS) (Continued)

SECTION VI - REACTIVITY DATA

Hazardous Polymerization: Conditions to avoid hazardous polymerization resulting in a large release of energy.

Stability: Conditions to avoid if unstable under normal circumstances.

Incompatibility: Materials to avoid.

SECTION VII - SPILL OR LEAK PROCEDURES

Reasonable precautions to be taken and the methods of cleanup to be used in the event of spillage of the product. Consult federal, state, and local regulations for accepted procedures and any reporting or notification requirements.

SECTION VIII - PROTECTIVE EQUIPMENT TO BE USED

This section indicates protective equipment to be used when handling the product.

ADDITIONAL COMMENTS

Serious accidents have resulted from the misuse of "emptied" containers (drums, 1- and 5-gallon pails, etc.). Refer to Sections IV and VII. To help reduce the possibility of an accident, disposal of containers must be in accordance with applicable laws and regulations. "Empty" containers must not be given to individuals. Only when applicable, containers should be punctured before they are disposed of.

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III — Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		

Incompatibility (*Materials to Avoid*)

Hazardous Decomposition or Byproducts

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI — Health Hazard Data

Route(s) of Entry: Inhalation? Skin? Ingestion?

Health Hazards (*Acute and Chronic*)

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure

Medical Conditions
Generally Aggravated by Exposure

Emergency and First Aid Procedures

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled

Waste Disposal Method

Precautions to Be Taken in Handling and Storing

Other Precautions

Section VIII — Control Measures

Respiratory Protection (*Specify Type*)

Ventilation	Local Exhaust	Special
	Mechanical (*General*)	Other

Protective Gloves	Eye Protection

Other Protective Clothing or Equipment

Work/Hygienic Practices

* U.S.G.P.O.: 1986-491-529/45775

1273 - SECURITY

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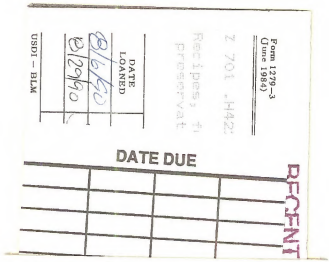

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